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9-1 General

9-1.1 Introduction

The quality of material used on the job will be evaluated, first by a laboratory examination of typical samples to determine whether deliveries can be expected to meet the specifications, or whether they can be made to do so; second, by tests of definite lots actually delivered on the job or set aside for shipment; third, by visual examination on the job to guard against defects in workmanship, damage in handling and contamination; and fourth, by verification samples to confirm that certified materials did, in fact, comply with the specifications.

The manner in which the work of controlling the quality of materials is to be divided between the Laboratory and the Project Engineer is given in detail in this chapter.

9-1.2 Requirements

Requirements for materials are given in Section 1-06 and Division 9 of the *Standard Specifications*. Tolerance limits and a procedure for acceptance of certain materials are given in Chapters 9-5.6 and 9-5.4 of this manual. Thickness of courses and tolerances are listed in Chapters 1-5.7 and 1-5.8 of this manual.

9-1.3 Sample and Test Numbering

A separate series of numbers, starting with No. 1 in each instance, shall be used for acceptance, assurance, independent assurance, and verification samples for each type of material for which there is a separate bid item. Assurance samples shall be referenced to the corresponding acceptance sample. Verification samples shall be referenced to the corresponding manufacturers certificate.

9-1.3A Preliminary Samples and Tests

Preliminary samples are intended to show the general character of the materials available or proposed for use. The sample may be taken from a natural deposit, the general stock of a dealer, or elsewhere. The materials sampled may require further treatment before it will meet the specification requirements. Preliminary samples are a basis for approving the source from which materials are to be obtained. Deliveries cannot be accepted on the basis of preliminary samples unless the samples represent an identified lot.

Unless specified for a particular purpose, sampling and testing materials from a potential source is not a mandatory function. It is to be performed when such results will be of value to the Project Engineer or when requested by the Contractor.

Before sampling a potential source, check to see whether previous test reports are available or reliable.

9-1.3B Acceptance Samples and Tests

Acceptance samples and tests are all of the samples and tests used for determining the quality and acceptability of the material and workmanship which have been, are being, or will be incorporated in the project. The results of these tests are to be used by WSDOT to determine conformance to contract documents. The minimum frequency for taking acceptance samples is detailed in Chapter 9-5.7 of this manual.

9-1.3C Assurance Samples and Tests

Assurance samples and tests are used for the purpose of making checks on the reliability of the results obtained in acceptance sampling and testing. Assurance samples and tests also serve to correlate results from field labs through the Regional Materials Laboratories and Olympia Service Center Materials Laboratory to the American Association of State Highway Officials (AASHTO) Materials Reference Laboratory (AMRL) and the Cement and Concrete Reference Laboratory (CCRL), that are operated by the National Institute of Science and Technology (NIST). The minimum frequency for assurance samples is detailed in Chapter 9-5.7 of this manual.

9-1.3D Verification Samples and Tests

Verification samples and tests are used for the purpose of making checks on the reliability of manufacturers test results when acceptance of the material is based upon a manufacturer's certification of compliance.

9-1.3E Ready Mix Concrete Plant Verification Inspection

Verification inspections shall be performed on all concrete plants furnishing concrete under a Certificate of Compliance. Inspections shall be made at least monthly when a plant is producing concrete under a Certificate of Compliance. Additional inspections shall be performed for each approximate 1,500 cubic meters (2,000 cubic yards) of concrete per month based on the frequency sampling requirements for fine aggregates (i.e., a verification inspection for every other fine aggregate sample). At least one day shall elapse between inspections.

Designation and assignment of individuals to accomplish the verification inspection shall be the responsibility of the Region. It is recommended that an individual experienced and familiar with the operation and inspection of concrete plants be assigned.

9-1.4 Form Letters

A number of form letters have been prepared as an aid in transmitting information to the Laboratory. In preparing letters of transmittal, care should be used to include all information that is in any way pertinent to the sample in question. Transmittal letters should be prepared in duplicate; the original is enclosed with the sample and the copy is retained by the Project Engineer. Following is a list of the forms used for transmittal of samples and/or information to the Olympia Service Center Materials Laboratory.

350-009 Concrete Test Cylinder Transmittal Letter
350-016 Asphalt Sample Label
350-026 Preliminary Sample Transmittal Letter
350-040 Proposed Mix Design
350-042 Report of Beam Test
350-056 Sample Transmittal
350-071 Request for Approval of Material Sources
350-074 Field Density Test
350-092 Asphalt Concrete Pavement Compaction Control Report
350-114 Summary Report of Acceptance Sampling and Testing
350-115 Contract Materials Checklist
351-006 Soil Sample Transmittal Letter
351-015 Daily Compaction Test Report
410-025 Transmittal of Falsework, Form and Shop Drawings

9-1.5 Material Certification

The Project Engineer will be responsible for all documentation required to certify a construction project for the materials incorporated in the project. The Project Engineer, through the Regional Operation or Construction Engineer, will be responsible for resolution of all deficiencies on the project with the Construction Office before certification is complete. The Regional Documentation Engineer will be responsible for reviews of the material documentation of the projects at the Project Engineer's office. The Region will be responsible for the preparation of the Certification of Material letter listing all deficiencies and their resolution. The Regional Administrator will be responsible for signing and distributing the certification letters. The Olympia Service Center Materials Laboratory will perform compliance reviews of the completed certified projects.

Definitions

Certification: Documented evaluation of the project activities for conformance to the contract provisions, *Standard Specifications* and *Construction Manual* procedures for inspection, testing, and acceptance of materials. The certification reflects the project's compliance with the Record of Materials as adjusted for:

1. Actual project quantities utilized,

2. Acceptance practices as provided in this manual for minor quantities of material, and

3. Adjusted sampling/testing frequencies as approved.

Deficiency: Any shortcoming in compliance with the Record of Material requirements as adjusted for actual quantities or in conformance of results of sampling, testing, or inspection with the contract requirements. All deficiencies are required to be listed, explained, and justified or resolved. Resolution and justification of deficiencies occurs after completion of all work on the project and receipt of all possible documentation from the contractor.

Material Certification Process

Olympia Service Center

1. Olympia Service Center Materials Laboratory (Contract Documentation Section)

   a. Prepare the Record of Materials for all items listed in the contract.

   b. Provide technical support, certification guidelines and format, and suggested documents. See Figure 9-1 for Contract Materials Checklist (DOT Form 350-115, latest version). See Figure 9-2 for Certification Letter and Distribution.

   c. Conduct the Certification Compliance Review in accordance with Section 9-I.5D.

2. The Construction Office (Documentation Engineer)

   a. Receive deficiencies identified during Regional Certification.

   b. Coordinate FHWA and Region to determine funding eligibility.

   c. Prepare response to Region identifying degree of nonparticipation (Letter of Resolution).

Region

1. Project Engineer

   a. Set up materials documentation system.

   b. Maintain Record of Materials item by item for materials certification.

Washington State
Department of Transportation

Contract Materials Checklist

Contract: _____ SR: _____ Fed. Aid #: _____
Title: _____

	Yes	No*	N/A	Item(s)
1. All items on ROM have approved sources, including items added by C.O.		**		
2. Approved sources were used for all items & source used is documented		**		
3. Use of approved proprietary products and QPL items is Documented				
4. Change of source letters were initiated when required (see 3-1.7 Const. Manual)				
5. Acceptance sample testing frequency is adequate with final quantities considered		**		
6. Assurance and verification of sample testing frequency is adequate with final quantities considered				
7. Acceptance sample test results produced satisfactory correlation with assurance test results		***		
8. Acceptance Sample test results produced satisfactory correlation with IAS test results		***		
9. All independent Assurance Samples are on file				
10. Justification is provided for all material which was accepted and incorporated into the project but which failed to meet specifications when tested		**		
11. Was a credit received for any nonspecification material used?		**		
12. All required approved catalog cuts and shop drawings are on file		**		
13. All required documentation for Inspected Items Acceptance (IIA) is on file		**		
14. IIA quantities match the final quantities		**		
15. All required Manufacturers Certifications & Mill Certs are on file		**		
16. The Manf. Cert. quantities match the final quantities		**		
17. Minor quantities are documented				
18. All material acceptance actions have satisfactory test results or other approved documentation prior to payment for the work				
19. Pavement & Surfacing depths meet plan requirements				
20. Pavement & Bridge widths meet plan requirements				

* All "No" checks constitute materials certification deficiency. These each require a comment or an explanation by the Project Engineer and an attachment to the Certification of Materials detailing the circumstances.

** These deficiencies reflect acceptance of nonspecification materials and may result in loss of participation on Federal Aid Contracts.

*** Follow up documentation for questionable & excessive deviations is attached.

Comments: (use additional sheet if necessary)

Project Engineer Signature _____ Date _____

Construction/Operations Engineer Signature _____ Date _____

DOT Form 350-115
Revised 9/94

◆ Supersedes Previous Editions ◆

Figure 9-1

Washington State
Department of Transportation
Sid Morrison
Secretary of Transportation

Transportation Building
P.O. Box 47300
Olympia, WA 98504-7300

(Name)
Assistant Secretary for Field
Operations Support Service Center
Transportation Building
Olympia, WA 98504

Cont. No: SR-
F.A. No.:
Section:

Date Completed:

Dear Sir:

This is to certify that:

The results of the tests on acceptance samples indicate that the material incorporated in the construction operations controlled by sampling and testing were in conformance with the approved plans and specifications, and such results compare favorably with the results of independent assurance sampling and testing.

Exceptions to the plan and specifications are explained on the attached sheet.

Very truly yours,

Regional Administrator

RGF
Attachment

cc: FHWA, 40943
OSC Materials Engineer, 47365
OSC Const. Documentation Engineer, 47354
OSC Comptroller, 47420
Regional Oper./Const. Engineer
Project Engineer

Figure 9-2

c. Identify, document, and justify **all** materials deficiencies including determination and acceptance of noncritical items in accordance with Chapter 1-2.8 of this manual.

d. Prepare certification package including identified deficiencies and submit to the Regional Operations Engineer for review. Certification Letter should be addressed to WSDOT Assistant Secretary for Field Operations Support Service Center.

2. Regional Operations/Construction Office

a. Review (by Regional Documentation Engineers) all projects according to Chapter 10-5 of this manual for documentation requirements including materials.

b. Resolve Materials deficiencies identified by Project Engineer through contact with the Construction Office Documentation Engineer.

c. Review Certification package for completeness.

d. Submit documentation to Regional Administrator for signature.

e. Distribute signed Material Certification. The original goes to the Assistant Secretary for Field Operations, with copies sent to FHWA, OSC Materials Engineer, OSC Construction Documentation Engineer, and OSC Comptroller. A copy of the letter of Resolution will be attached if there are any deficiencies.

3. Regional Administrator

a. Sign Material Certification letter (may be subdelegated to the Operations/Construction Engineer).

4. Olympia Service Center Accounting

a. The federal aid section will make the appropriate transaction as necessary upon receipt of the Letter of Resolution.

b. Voucher a federal project only after receiving a copy of the Material Certification and the Letter of Resolution and insuring that the appropriate credit has been made to FHWA.

c. Attach a copy of the Letter of Resolution to the Journal Voucher sent to FHWA.

Compliance Review for Delegated Materials Certification Process

A Compliance review will be performed annually in each Region by the Olympia Service Center Materials Laboratory. The purpose of the compliance review is to ensure that project records conform to materials certification standards.

Upon receipt of a copy of the Material Certification letter from the Regional Operations/Construction Office, the Olympia Service Center Materials Laboratory will notify the Region within thirty (30) days of an intent to perform a compliance review on that contract. A compliance review if needed will be scheduled no later than 180 days after notification to the Project Office.

The compliance review will normally be conducted at the project office unless arrangements are made for it to be conducted elsewhere.

The goal is for the compliance reviews to be conducted on at least 10 percent of each regions contracts with a minimum of one per project office every two years. Compliance reviews may be conducted more frequently when deemed necessary. The contracts will be selected at random from all contracts with consideration given to contract size and complexity.

This review is of the records kept and developed by the Project Engineer for acceptance of the materials and the identification of deficiencies.

Upon completion of the review on any contract, the reviewers will discuss the findings with the Region. A report of the findings will be prepared and sent to the Regional Operations/Construction Engineer within 60 days after the review. A copy will be sent to the Regional Documentation Engineer and the Project Engineer.

When the Compliance Review shows a discrepancy of a serious nature, the Regional Operations/Construction Engineer will correct any such discrepancy in the process.

The following items of documentation are required to develop the Material Certification and must be made available for review:

1. Record of Materials.
2. Request for Approval of Material Source.
3. Comparison of Quantities (Region Final).
4. List of Change Orders.
5. Reduced Frequency Testing Approval.
6. Test Results.
   a. Acceptance Test Reports.
   b. Assurance Test Reports.

c. Independent Assurance Test Reports.

d. Verification Test Reports (Cement and Liquid Asphalt).

7. Manufacturer's Certificates of Compliance.

a. Concrete Pipe Acceptance Report.

b. Lumber Grading Certs.

c. Certification of Cement Shipment.

d. Notice of Asphalt Shipment or Certified Bill of Lading.

8. Inspected Items Acceptance.

9. Catalog Cuts (Product Data Sheet).

10. Minor Quantity Acceptance Documentation.

11. Proprietary or QPL Item Acceptance Documentation.

12. Sign Acceptance Report.

13. Follow-up actions for unsatisfactory correlations between IAS and Acceptance Sample Test Results.

14. Final Record Measurements for Pavement and Surfacing Depths.

The origin, purpose, and description of these items are described in the following paragraphs 9-1.5 A through G.

9-1.5A Record of Materials

A listing of all major construction items is provided by the Olympia Service Center Materials Laboratory on the Record of Material. The Record of Material is a computer generated document and contains the kind and the quantity of all material deemed to require quantity control testing and the minimum number of acceptance, assurance, and independent assurance samples required. Also listed are those materials requiring other actions, such as fabrication inspection, Manufacturer's Certification of Compliance, shop drawings, catalog cuts, etc. The action or number of samples listed is the minimum required for materials certification by the Project Engineer and reflects the acceptance of minor quantities, those items for which plan quantity is less than an established threshold value. The Olympia Service Center Materials Laboratory will forward the Record of Material electronically to the Regional Administrator, Regional Materials Engineer, and Project Engineer shortly after the contract is awarded. The copy for the Project Engineer is intended to be used for keeping records of samples approved, samples tested, Material Acceptance reports received, and other pertinent data. The copy for the Regional Materials Engineer is intended to provided guidance to the Regional independent assurance samplers.

9-1.5B Request for Approval of Materials Source

Approval of source must be received from the Olympia Service Center Materials Laboratory or delegated authority for materials listed on the Record of Materials and as required by Chapter 9-4 of this manual. Requests shall be submitted by the Contractor on DOT 350-071. If the source requested by the Contractor is shown in the Approved Source of Materials Volume I or Volume II (Approved Pits and Quarries) and within the delegated authority of the Project Engineer to approve, the Project Engineer will note the approval action and the file number, sign and date the form, distributing copies as shown on the form. If the source requested is not within the delegated authority or not shown in the Approved Source of Materials Listing, the Project Engineer shall so note by the use of Approval Action Code No. 7, sign and date the form, and transmit the original to the Olympia Service Center Materials Laboratory for approval action.

Following Approval of Source by the Olympia Service Center Materials Laboratory, beyond the Project Engineer's delegated authority, subsequent requests for the same source and specified item on other contracts administered by the same Project Engineer may be approved at the project level. Such delegated approval action may be made within 12 months from the date of the original Olympia Service Center approval. The request (RAMS) should be annotated as to the Contract on which original approval was made. A copy of the "transferred approval" should be distributed to the Olympia Service Center Materials Laboratory Documentation Section.

Approvals requested in fulfillment of special requirements or substitutions as equivalents shall also be annotated as directed on the form. At the discretion of the Project Engineer, a request for approval of source may be required for those materials not listed on the Record of Materials for which there exists some doubt as to their acceptability. When a source or product is specifically called for in the contract documents, a request for approval of source need not be submitted unless the Contractor elects to use an alternate source or product. If the Contractor elects to use an alternate quarry or pit site, a letter requesting the change shall be submitted in accordance with Chapter 3-1.7 of this manual. When requesting approval of an item that requires fabrication, both the fabricator and the manufacturer of the base material will be identified. An inspection of the fabrication facility may be required prior to approval. The Olympia Service Center Materials Laboratory will make arrangements for such inspection. Fabricated items include structural steel, sign structures, precast median barrier, culvert pipe and others. See Chapter 9-4 of this manual for further details regarding fabricated items. In general, if an

item requires shop inspection, it can be considered to be a fabricated item.

As soon as the Project Engineer receives approval of the materials source, one copy of the approval shall be transmitted to the Contractor so materials can be procured. The date the Contractor was notified of the approval should be noted on the Project Engineer's copy.

The Project Engineer will keep accurate field notes of the sources from which each material was obtained. If the same kind of material is obtained from two or more sources, the notes will show on which portions of the work each was used. A summary of this information must be included in the Final Record Notes.

9-1.5C Vacant

9-1.5D Inspected Items Acceptance

Items which are inspected and found acceptable by a WSDOT Materials Fabrication Inspector are identified by a tag or stamp. These items formerly required follow-up action to generate a Materials Acceptance Report. These reports are no longer issued as the inspection tag or stamp constitutes acceptable evidence of conformance. This acceptance by inspected item tag supersedes and replaces the Materials Acceptance Report process. The tag or stamp with an identification number ink stamped on the inspected item or ink stamped on an "Approved For Shipment" tag attached to the inspected item attests that the item was in full conformance with specifications at the time of inspection. The ID number will be six digits prefixed with a letter. The letter identifies the Materials Inspector who inspected the item.

The Inspected Item Acceptance: Tag Identification table is a general guide for the items. Check the Record of Materials for documentation requirements. "Approved for shipment" items accepted on the basis of a tag or stamp require follow-up action by the Project Engineer to complete the inspection documentation.

The actions to obtain inspection are:

1. The source of the item must be approved.

Approval of source is given via the "Request for Approval of Material Sources" form. A copy of the approved Request for Approval of Material Sources is provided to the Fabrication Inspector in the area where the fabrication is taking place. This provides advance notice of the need for inspection.

If a verbal approval of source is given shortly before fabrication is to begin, it is the Project Engineer's responsibility to contact the appropriate Fabrication Inspector to make arrangements for inspection. If the Project Engineer fails to contact the Fabrication Inspector in cases of verbal approval of sources, it is likely that the proper inspection will not take place.

2. The item of work must be inspected by the WSDOT Fabrication Inspector.

The only evidence of inspection at this point is the stamp or tag which says "Approved for Shipment WSDOT" with an ID number.

3. At the time of inspection, the Fabrication Inspector will obtain the necessary mill tests or other documentation from the manufacturer and file reference them to the ID number.

4. The Project Engineer must verify delivery of the items to the project by means of an "Approved For Shipment WSDOT" tag or stamp with an ID number.

The Project Engineer's responsibilities are summarized as follows:

1. Check the Record of Materials to see which items require off site inspection.

2. Ensure that Requests for Approval of Material Sources indicating fabrication sources are submitted by the Contractor in a timely manner. Two weeks is usually adequate from receipt of request to completion of inspection. In case of delayed or rush submittal or verbal approval because of imminent fabrication, contact the Fabrication Inspection Supervisor to make sure that arrangements have been made.

3. Once the fabricated item arrives on the job, check for "Approved for Shipment" stamps or tags with ID numbers. If there are no stamps or tags, inform the Contractor that the item is not acceptable and call the Olympia Service Center Materials Laboratory for instructions. Items lacking tags or stamps are not acceptable. They have either not been inspected or, if inspected, have been found not acceptable under the specifications.

4. If there are "Approved for Shipment" stamps or tags with ID numbers, record ID number, quantity, and brief description of the item for project records. The field inspector should note on their reports that the material was in satisfactory visual condition when installed and forward all information to the project office. In case of questions concerning an inspect item contact should be made with the inspection offices.

Seattle Inspection Office, Mail Stop NB-82, Northwest, MS-501
Spokane Inspection Office, Mail Stop Eastern, Materials Lab

Inspected Item Acceptance: Tag Identification

Item	*Tag Identification Number*
• Treated timber and lumber except guardrail post and blocks • Treated piling • Epoxy coated rebar • Anchor bolts • Type 1 raised pavement markers	Inspected in "lots," ID Nos. repeated and representative number of tags placed on each shipment (each item not tagged)
• Bearings • Miscellaneous items that are shop welded • Miscellaneous galvanized steel items • Concrete and metal culvert pipe over 700 mm (27 inches) in diameter • Precast concrete panels • Prestressed concrete girders • Permanent precast concrete median barrier • Steel for bridges • Traffic signal and illumination standards • Vaults (depending on ROM requirements) • Drainage metal castings	ID Nos. repeated (each item tagged with the same number)

Vancouver Inspection Office, Mail Stop Southwest S-15, Materials Lab

5. At the conclusion of the project, the records should be reviewed to determine that for all applicable materials were documented by numbered inspection tags.

9-1.5E Manufacturer's Certificate of Compliance

As designated by the specifications and special provisions, certain materials may be accepted on the basis of a Manufacturer's Certificate of Compliance. This acceptance is an alternate to job site sampling and testing. The Record of Materials is prepared to indicate the required sampling and testing and should provide a guide to the items for which a compliance certification is an acceptable basis of acceptance. The compliance certificate is required prior to installation of the material. Where this requirement is waived by written agreement, no payment shall be made for the work until the certification is received.

Acceptance by certificate will be permitted where designated by the contract provisions. The Record of Materials will provide a summary of requirements combining the special as well as general requirements of the contract.

The form of the certificate will vary considerably based on both the material and the origin and will range from standard state certificate forms, to individual letters from manufacturer's, to overstamps on bills of lading. Certain information is required and is designated by the specifications. This information includes the identity of the manufacturer, the type and quantity of material being certified, the applicable specifications being affirmed, and the signature of a responsible representative of the manufacturer. Supporting mill tests or documents may also be required. A certificate is required for each delivery of material to the project and the lot of material being certified shall be identified.

Upon receipt of the certification at the project level, it shall be reviewed for compliance with the specifications requirements using the preceding guidelines and the checklist for Transmittal of Manufacturer's Certificate of Compliance Form 350-572. The certification must be made by the manufacturer of the material. A supplier certificate is not acceptable except as evidence for lot number and quantity shipped and can only be accepted when accompanied by a certificate from the manufacturer which meets the requirements of Section 1-06.3 of the *Standard Specifications*.

If all the checklist items can be answered "YES," the Project Engineer shall sign the completed checklist thereby "APPROVING" the Manufacturer's Certificate of Compliance, attach a copy of the Manufacturer's Certificate of Compliance and make the distribution as shown on the checklist.

If all the checklist items except No. 2 and 7a, cannot be answered "YES," the Project Engineer shall sign the completed checklist, attach the Manufacturer's Certificate of Compliance and return it to the Contractor for corrections, clarification, and resubmit for approval and payment.

When routing to the Olympia Service Center Materials Laboratory, it is to be addressed Attention: Contract Documentation Section.

9-1.5F Concrete Pipe Acceptance Report

A modified form combining features of certified compliance and fabrication acceptance is utilized for concrete pipe. Fabrication inspection is periodically performed at approved sources of concrete pipe. During this inspection, samples of each type, size, and class of pipe are inspected and tested to verify compliance with the Standard Specification. For a 90-day period of manufacture from the date of inspection, concrete pipe less than 750 mm diameter may be shipped and accepted based on "Concrete Pipe Acceptance Reports." This report is prepared by the Fabrication Inspector and copies are thereafter supplied by the fabricator to accompany each shipment of pipe.

The Acceptance Report as received on the project will indicate the date and original test results as performed by the Fabrication Inspector and will bear a certification from the fabricator as to the certificate's application to the particular shipment it accompanies. The project inspector is responsible to verify the conformance of the shipment with the contract requirements and to examine the manufacture and shipping dates of the pipe for conformance with specifications and with the Acceptance Report. Upon such verification, the inspector will note receipt of the material for the specific contract and route the Acceptance Report to the Olympia Service Center Materials Laboratory, Attn: Contract Documentation Section.

9-1.5G Sign Acceptance Report

The Sign Acceptance Report (SAR) is prepared to verify that the signs have been inspected and approved for shipment to the project by having a "Fabrication Approved" decal attached.

1. The Project Engineer will make approval of source for the sign fabricator for those fabricators which are within the Project Engineer's delegated authority to approve, or forward the original Request for Approval of Material Sources to the Olympia Service Center Materials Laboratory for approval action.

2. The Project Engineer, after approving the sign fabricator, will notify the appropriate sign fabrication inspector of the need to provide sign fabrication inspection and provide the inspector with a detailed list of the types of signing materials intended for use on a specific project. Sign fabrication inspectors shall be contacted by letter and shall be provided with necessary plans and change orders to conduct an inspection. The Project Engineer shall use the form letter attached to the Record of Materials to notify the sign fabrication inspectors.

Sign Fabrication Inspectors

Seattle-Tacoma area — Contact Olympia Service Center Traffic or Northwest Region Traffic
Vancouver-Portland area — Contact Southwest Region Traffic Operations
Spokane-Eastern Washington — Contact Eastern Region Materials

3. The sign fabrication inspector will obtain from the fabricator samples of any untested lots of reflective sheeting and legend which have not been accepted for use under WSDOT specifications, and send them to the Olympia Service Center Materials Laboratory for testing. Test results will be sent back to the sign fabrication inspector. The inspector shall have all test reports on hand indicating that the lots of materials used in fabricating the signs are acceptable prior to making the final inspection of the signs and tagging the signs "FABRICATION APPROVED." As a follow-up to the inspection, the inspector will prepare the SAR, which includes date of fabrication inspection, an itemized list of all signs inspected, and source and heat/lot numbers for materials used in the fabrication of the signs. The SAR will be sent to the Project Engineer after all the signs have been inspected and approved for shipment.

The sign fabrication inspector shall have the following materials documentation at the time of sign fabrication:

1. Sign blanks or panels: Manufacturers Certificate of Compliance with accompanying mill certifications.

2. Reflective Sheeting and Cutout Legend: Test report from the Olympia Service Center Materials Laboratory for the lot of reflective sheeting and/or legend accepting the specific lot of reflective sheeting and/or legend used in the sign fabrication.

> **Note**: Reflective sheeting, legend, and prismatic reflectors shall be tested and accepted based on a "lot" of material. A "lot" is defined as the amount of sheeting or legend received by a fabricator in a single shipment. All rolls or individual shipping units within a lot shall be sampled, tested, and marked.

3. Demountable Legend and Prismatic Reflectors: Test result of sampled lot of materials indicating conformance with specifications.

The Sign Acceptance Report (SAR) shall include date of sign fabrication inspection, itemized list of all signs inspected, source, and heat or lot numbers for materials used to fabricate signs.

The Project Engineer will accept for installation and payment only those signs which have a "FABRICATION APPROVED" decal affixed. The SAR provided by the signing fabrication inspector will complete the documentation certifying the signing materials as to specification conformance.

9-1.6 Control of Materials

The succeeding parts of this chapter on materials outline the detailed method to be used in the control of materials. The expenditure made for materials is a large item in construction costs. If faulty materials are permitted to go into the work, the cost of replacement may exceed the original cost manyfold.

Chapter 9-2, Sampling Methods, is covered in considerable detail because of the importance of taking samples and performing tests by standardized methods. Careless methods of sampling and testing are inexcusable. The methods outlined have been carefully considered and must be followed in detail.

Chapter 9-3, Testing, describes the field equipment for testing and explains the proper test method to use for various materials. The field equipment for testing is a list of the major items needed for making field tests. The lists are not intended to cover minor items nor miscellaneous office supplies that may be needed.

Chapter 9-4, Specific Requirements for Each Material, includes the following information:

1. Whether or not an approval of source is required.

2. Whether or not a preliminary sample is required. If so, the size of sample needed is stated.

3. The basis on which materials are to be accepted as satisfactory for incorporation into the work.

4. Whether or not an assurance or verification sample is required. If so, the frequency that assurance or verification samples are to be sent to the laboratory, the size of the sample and the container in which the sample should be sent.

5. Samples are to be obtained and sent to one laboratory.

6. The visual inspection and the tests that must be made on the job.

7. Specification requirements.

Chapter 9-5, Guidelines for Job Site Control of Materials, provides the Engineer with additional information to assist in determination of the point of acceptance for materials from WSDOT and Contractor sources, the Basis of Acceptance, assurance or verification sampling and testing, tolerance limits, and the sampling and testing frequency guide.

Chapter 9-6, Radioactive Testing Devices, explains policy on the administration of radioactive testing devices.

Chapter 9-8, WSDOT Test Methods.

9-2 Sampling Methods

9-2.1 Sampling Natural Deposits

This chapter includes sand and gravel pits, rock ledges, talus, and filler pits.

Sampling of natural deposits requires the utmost care and the exercise of the best judgment. Concurrently with the taking of samples, a careful estimate must be made of the quantity of material represented by each sample as well as the amount of material available in the deposit as a whole. Numerous instances of sites not proving out when operated, and the resulting costly moves, furnish ample evidence of the necessity for care in prospecting.

The first step in prospecting is to determine the logical place for the plant set-up and how the material can best be obtained. Then decide on the area and depth that can be worked economically. With this information in mind the logical place to take samples can be determined.

If crushed surfacing is to be made from sand and gravel pits, there must be a place provided to waste sand.

The availability of water for washing purposes during wet and dry seasons must be determined if concrete aggregates or mineral aggregates are to be produced. If washing is necessary, a site for the settlement of silt, before returning water to the stream, must be provided to comply with the requirements of the Departments of Ecology, Fish, and Wildlife, and our reclamation specifications.

A personal inspection by a representative of the Olympia Service Center Materials Laboratory will be required for each new site investigated and for each site previously used if there is any question as to the existence of satisfactory material. The Laboratory representative need not be present during the actual prospecting operations, but it is required that the personnel who do the prospecting shall point out to the representative at the site exactly how and where the sampling was done. The Laboratory representative will require that the sampling frequency be in accordance with the requirements listed hereinafter.

If it is necessary to fill the test pits before the Laboratory representative can make an inspection, representative samples of each type of material found in the test pits should be retained for examination. The presence of the Laboratory representative should be requested while sampling is in progress for pits and quarries that appear likely to be approved for an early project.

Complete notes on all features of the deposit should be taken during the prospecting. In the case of sand and gravel pits, such items as overburden depths, changes in grading with depth, presence of silt or clay balls, and presence of silt lenses and depths at which they occur are important factors in the analysis of the site.

In the case of ledge rock deposits, important features to be noted are the presence of vesicular rock, plastic material in seams of rock, and the manner in which the material is jointed. The geologist will need this information to complete an evaluation of the proposed source.

9-2.1A Sand and Gravel Pits

If a large cut face is exposed, good samples may be obtained there. Care must be taken to dig away all material that has sloughed from the face and all material on the face of the pit that has been washed by rain should be discarded. If greater depth than the exposed face is desired, sink a test pit at the foot of the slope. Deep test pits back of the face of the pit will be necessary except when there is no doubt at all of an ample supply of material. In such a case, however, shallow test pits should be dug to determine the depth of overburden over the area to be worked.

There are many instances of previously worked pits where the logical place to secure aggregate is from the floor of the pit thus obviating the necessity of stripping. In such cases sink test pits to determine the depth and character of material available.

The extremities of the pit should be tested first and then test pits sunk at 60-meter (200-foot) intervals. If the material is uniform in all holes it will not be necessary to test intervening spaces.

When there is no cut face present, test pits must be sunk to sufficient depth to prove a supply of satisfactory aggregate. Although there are many signs that may indicate the extent of a deposit, it is not logical to consider a test pit as indicative of the character of material for more than a 15-meter (50-foot) radius. Therefore, where large amounts are

required, test pits should be sunk at 30-meter (100-foot) intervals.

After test pits have been dug, notes should be taken on the following points while securing samples: The depth of overburden soil, the depth to which the material appears to be coated with clay or covered with stains that are difficult to remove by washing, the depth to which clay balls or disintegrated rock are present, and variations in the grading of the material. Separate samples should be taken for each change in character or grading encountered. Separate groups of samples should be taken from each test pit.

When preparing the samples for shipment to the Laboratory several things should be considered. Samples of material of different character should be sent separately with notes of the depth represented. Material of the same general character but of different grading can be combined in the field provided amounts proportional to the depth of each layer are taken.

The quantity needed for laboratory examination will vary with conditions. If the material appears to be reasonably uniform in composition 50 kilograms (100 pounds) will be sufficient. Obviously, samples of these amounts must be taken carefully to indicate the grading with any degree of accuracy. If the material appears to be unsatisfactory at certain depths, send separate 25-kilogram (50-pound) samples of such material.

If laboratory examination for use as concrete aggregate is desired, or may be requested based on preliminary test results, a larger sample of 250 to 300 kilograms (500 to 700 pounds) will be necessary. Therefore, it is always good policy to reserve a quantity sufficient for this purpose before filling the test pits.

9-2.1B Talus

Methods of prospecting and sampling talus will be similar to that for sand and gravel. It should be remembered that solid rock may lie close to the surface of an apparently deep deposit.

9-2.1C Ledge Rock

In examining ledges remember that the hardest, most resistant rock is always exposed most prominently and that softer rock probably occurs in the seams and depressions.

The rock in the greatest area of the state is basalt. This is formed by lava flows and the rock may be underlaid by soil of any description; therefore, it cannot be concluded that there is an unlimited depth to the deposits. In eastern Washington the rock is of comparative recent geological formation and will generally be found to be fairly uniform in composition throughout with the exception that the upper layers (as formed) are more or less vesicular (containing blow holes) which form a point of attack for weathering agencies. Several flows with long intervals between may have covered the same area in which case there may be several layers of dense and vesicular rock alternating. Basalts of western Washington, except in places along the Columbia River, are of older geological origin and usually have been subject to considerable alteration. Many of the western Washington basalts were formed by lava flowing into the water with the result that often they are intermingled with shales stirred up from the bed of the body of water. Sometimes they cooled so rapidly that glasses were formed which may, after quarrying, devitrify causing the rock to lose its strength. Coarse grained rocks have been formed either through intrusion from the depths of the earth or from very large lava flows. Coarseness of grain is usually an indication of a large quantity of rock although all of it may not be accessible.

Unless the quarry site has been opened up it will be necessary, in the majority of cases, to test-drill the ledge. When the volume of the rock is large compared to the quantity required and there are good surface indications of its uniformity, two or three holes may be drilled by hand and shot to secure samples. In more doubtful cases, down-holes or coyote holes should be drilled. At least one hole should be shot to obtain a sample.

From the way the rock shoots and by observation of seams and planes of fracture, an idea can be obtained of the size to which the rock will break in quarrying.

9-2.2 Sampling Manufactured Aggregates

The principal requirement in sampling concrete and mineral aggregates produced from operating plants is that the samples shall be as nearly representative of the general production of the plant as possible. No inexperienced person should be assigned to the work of sampling without good indoctrination in actual sampling by an experienced person.

The specifications require that aggregates meet grading and quality requirements at the time they are placed in hauling vehicles for delivery to the roadway or placement in a temporary stockpile except aggregates for portland cement concrete shall meet the requirements for grading and quality at the time they are ready for introduction into the mixer and aggregates for asphalt concrete shall meet sand equivalent and fracture requirements at the time of its introduction to the cold feed of the mixing plant and meet the gradation requirements in the final mix.

If aggregate is stockpiled at the pit site prior to use and will be hauled directly to the work from the stockpile, samples taken during the manufacture of the material will suffice for quality control provided that the stockpile is built in a workmanlike manner in accordance with the specifications.

If the Inspector feels that the Contractor has permitted contamination or abnormal segregation to occur in the stockpile due to the methods of stockpiling, the Inspector should sample the stockpile, preferably with an auger, and base acceptance of the material on the results of tests of representative samples from the stockpile.

9-2.2A Coarse Aggregates

At Crushing or Washing Plant: The Contractor shall provide an automatic or semi-automatic sampling device for obtaining samples in accordance with Section 1-05.6 of the *Standard Specifications*. The samples must be representative of the material being produced and at least large enough to yield the quantity required for the screen test.

Scows: If scow loads are stockpiled prior to use, sample the material after stockpiling. If the material goes directly from the scow to the mixer, have the load worked over with a clam shell. Take 100-kilogram (250-pound) sample, spread on floor or canvas and compare appearance of sample with the load on the scow. If sample appears representative, quarter down to size required.

Large Stockpiles: Large stockpiles should be tested during production but it may be necessary to check the contents. If it is not possible to obtain samples with a power auger start trenches at the sides near the top and work down towards the bottom making the trenches increasingly deep. Take samples at regular intervals along the trenches. Samples thus taken should total not less than 100 kilograms (250 pounds) which may be spread out and quartered to the size needed.

9-2.2B Fine Aggregates

The use of sampling tubes is recommended as a time-saver but satisfactory samples can be obtained by digging deep holes and scraping along the side of the holes. Samples should contain very little, if any, fine aggregate from the outer surface of piles because of the tendency for large grains to run to the bottom. Concrete aggregate deposited on the ground directly from the washing plant is apt to be very erratic in grading. The material should not be sampled at that point if it can be avoided.

Fine aggregate samples can be split to the size required more rapidly and accurately when damp than when dry. If the material is dry when sampled, the samples should be moistened before splitting.

9-2.3 Sampling Fresh Concrete

See WSDOT Test Method 803 — Method of Sampling Fresh Concrete.

9-2.4 Random Sampling

Use WSDOT Test Method 716 — Method of Random Sampling for Location of Testing and Sampling Sites.

9-2.5 Sample Size

The listing below indicates the required quantity for necessary testing. It is not critical that this amount be handled and shipped in a single sample container. Dividing the total sample into two or more sacks is permissible in order to accommodate the physical strength of the technician.

Preliminary samples should be a minimum of 35 kilograms (80 pounds) each unless specified otherwise in Chapter 9-4.

Assurance or verification samples to be sent to the Laboratory should be approximately the following mass (weight).

Item	Mass (Weight) per Sample
Gravel Borrow	25 kg (50 lbs.)
Sand Drainage Blanket	25 kg (50 lbs.)
Gravel Base	25 kg (50 lbs.)
CSTC	25 kg (50 lbs.)
CSBC	25 kg (50 lbs.)
Maintenance Rock	15 kg (30 lbs.)
Ballast	25 kg (50 lbs.)
Shoulder Ballast	25 kg (50 lbs.)
Backfill for Sand Drains	15 kg (30 lbs.)
Coverstone	15 kg (30 lbs.)
Cr. Screenings	15 kg (30 lbs.)
Gravel Backfill	25 kg (50 lbs.)
PCC Coarse Aggregate	25 kg (50 lbs.)
PCC Fine Aggregate	3 kg (5 lbs.)
Cement	5 kg (10 lbs.)
Asphalt Treated Base	
Aggregate	15 kg (30 lbs.)
Completed Mix	10 kg (12 lbs.)
Asphalt Cement Concrete	
Coarse Aggregate	15 kg (30 lbs.)
Fine Aggregate	10 kg (25 lbs.)
Blending Sand	5 kg (10 lbs.)
Mineral Filler	1.5 kg (3 lbs.)
Completed Mix	10 kg (12 lbs.)
Asphalt Materials	1 L (1 qt.)

Acceptance samples for sieve analysis should be the approximate size as shown in WSDOT Test Methods 102 and 104.

9-2.6 Sampling of Geotextiles

Use WSDOT Test Method 914 — Practice for Sampling of Geotextiles for Testing.

9-3 Testing

9-3.1 Field Equipment for Testing

9-3.1A Introduction

The following lists are given as a guide in assembling equipment necessary for the field inspection of the various materials. Unless otherwise noted, the items can be obtained from the Regional Materials Laboratory.

9-3.1B Concrete Aggregate

1 Sand sampling tube.

2 13-liter to 19-liter (3.5- to 5-gallon) water buckets.

6 Pans about 330 mm × 230 mm × 50 mm (13 × 9 × 2 inch) deep.

1 Set gravel screens with 37.5-mm (1½-inch), 31.5-mm (1¼-inch), 19.0-mm (¾-inch), 9.50-mm (⅜-inch), and 4.75-mm (No. 4) square opening screens.

1 Platform scale capacity 50 kilograms (125 pounds) by 0.01 kilograms (0.01 pounds).

1 Set sand sieves, 200 mm (8 inches) with pan and cover. The following sieves will be required: 4.75 mm, 3.35 mm, 2.36 mm, 1.18 mm, 0.60 mm, 0.30 mm, 0.150 mm, and 0.075 mm (U.S. No. 4, 6, 8, 16, 30, 50, 100, and 200).

1 Brass wire brush such as used for cleaning aluminum ware. (Purchase locally.)

1 Electronic balance, 11,000 gram Mettler PM 11 or equal reading to ⅒ gram.

1 Hot plate, gasoline stove, or equivalent.

1 Tablespoon. (Purchase locally.)

1 Colored glass for organic matter test.

6 250 ml (½ pint) milk bottles. (Purchase locally.)

2 950 ml (32 oz.) graduated prescription bottles. (Purchased at drug store.)

1 Sample splitter.

1 Preserving kettle with lip, not less than 1 liter (4 quart) by 100 mm (4 inches) deep. (This is required only when fine aggregate contains doubtful amounts of silt. Purchase locally.)

1 Shovel.

1 Piece heavy canvas, 2- to 3-meters (6- to 8-feet) square.

1 Glass-top Pycnometer Kit (for rapid test for water in sand). Supply of denatured alcohol. (Required only when hot plate not available for drying aggregates. Purchase locally.)

Supply of 3 percent sodium hydroxide. (Purchase made up at drug store, or purchase stick sodium hydroxide or household lye and make up solution containing 32 grams per liter (quart) of water. Use reasonable care in handling to avoid injury to skin.)

Supply of canvas sacks or plastic bags for shipping sand samples.

Supply of canvas sacks or 20-liter (5-gallon) plastic buckets in good condition for shipping gravel samples. (Obtain through Region Stores.)

9-3.1C Mineral Aggregates

2 Water buckets.

6 Pans about 300 mm × 300 mm × 50 mm deep (12 inches × 12 inches × 2 inches deep).

1 Set gravel screens, rocker type with screens as specified for types to be constructed. A portable set of screens is also available and may be used if preferred.

1 Platform scale.

1 Set sand sieves, 200 mm (8 inches) diameter, full height preferred, 6.30 mm and 2.36 mm, 2.00 mm, 0.85 mm, 0.425 mm, 0.30 mm, 0.180 mm, 0.150 mm, and 0.075 mm (U.S. No. 8, 10, 20, 40, 50, 80, 100, and 200).

1 Mechanical sieve shaker.

1 Brass wire brush such as used for cleaning aluminum ware. (Purchase locally.)

1 Electronic balance, 11,000 gram Mettler PM 11 or equal reading to ⅒ gram.

1 Hot plate, gasoline stove or equivalent.

1 Tablespoon. (Purchase locally.)

1 Piece heavy canvas, 2- to 3-meters (6- to 8-feet) square.

1 Sample splitter.

1 Sand Equivalent Kit.

Supply of canvas sacks or plastic bags for shipping fine aggregate samples.

Supply of canvas sacks or 20-liter (5-gallon) plastic buckets for shipping samples of coarse aggregate. (Obtain through Region Stores.)

9-3.1D Asphalt Road Materials

1 Pocket dial thermometer, 304 stainless steel stem, accurate to 1 percent of range, and range of 10°C (50 F) to 260°C (500 F) in five divisions.

1 Funnel, not soldered for use in filling sample cans.

Supply of 1-liter (1-quart) metal cans with felt and foil lined screw caps for shipping samples of all cutback and paving grade asphalt materials.

Supply of 1-liter (1-quart) plastic containers with lids for shipping samples of emulsified asphalt.

9-3.1E Surfacing Materials

1 Platform scale.

1 Set gravel screens, rocker type, with screens as specified for types being constructed.

1 Set sand sieves, 200 mm (8 inches) diameter, full height preferred, 6.30 mm and 2.36 mm, 2.00 mm, 0.85 mm, 0.425 mm, 0.30 mm, 0.180 mm, 0.150 mm, and 0.075 mm.

1 Sand equivalent test kit.

1 Sample splitter.

Supply of canvas sacks for shipping samples. (Obtain through Region Stores.)

9-3.1F Pavement Concrete

1 Slump cone.

1 16 mm × 600 mm ($^5/_8$ inch × 24 inch) bullet-pointed rod.

1 Field beam testing machine.

2 Test beam molds.

1 Square-ended spade.

1 Concrete vibrator (loaned by laboratory on request).

1 0.1 or 0.2 cubic meter ($^1/_2$ inch or $^1/_3$ cubic foot) bucket.

1 Platform scale.

1 Air meter.

1 Glass plate for yield bucket.

1 Wheelbarrow.

1 150 mm (6-inch) scoop.

3 20-liter (5-gallon) plastic buckets.

1 75 mm (3-inch) wide trowel.

9-3.1G Structural Concrete

1 Slump cone.

1 16 mm × 600 mm ($^5/_8$-inch × 24-inch) bullet-pointed rod.

1 0.1 or 0.2 ($^1/_2$ or $^1/_3$) cubic meter (foot) bucket.

1 Platform scale.

1 Air meter.

1 Glass plate for yield bucket.

1 Wheelbarrow.

1 150 mm (6-inch) scoop.

3 20-liter (5-gallon) plastic buckets.

1 75 mm (3-inch) wide trowel.

1 Curing box.

Supply of test cylinder molds.

9-3.1H Soil and Surfacing Density

1 A nuclear densometer.

1 Tool box with set of tools.

1 Large iron spoon.

1 Tablespoon.

1 50-mm (2-inch) paint brush.

4 4-liter (1-gallon) paint cans.

1 Platform scale, 25-kilogram (50-pound) capacity.

2 Pan 300 mm × 450 mm × 50 mm deep (10 inches × 12 inches × 2 inches deep).

1 Small ointment can.

1 2-meter (6-foot) folding rule.

9-3.1I Proctor Density Equipment

1 101.6-mm (4-inch) I.D. mold.

1 Standard compacting hammer.

1 Straightedge.

1 Mixing trowel (or spoon).

1 Electronic balance, minimum capacity 2,600 grams.

1 Large scale (see 9-3.1H).

1 Pan 300 mm × 300 mm × 50 mm (12-inch × 12-inch × 2-inch).

9-3.1J Asphalt Mixtures

1 Long handle, square point shovel.

3 20-liter (5-gallon) paint buckets.

1 Tablespoon, 300 mm (14-inch).

1 1.5 meter × 1.5 meter (4-foot × 4-foot) piece of canvas.

1 Electronic balance, 11,000 grams readable to .1 gram.

1 Maximum specific gravity density kit (Rice).

1 Set of sieves and shaker (see 9-3.1C).

Asphalt quick wash kit including:

Buchner funnel, 150- or 200-mm (6- or 8-inch) diameter.

Filtering flask, 4,000 milliliter.

Vacuum pump or aspirator capable of maintaining an air pressure less than 30 millimeter of mercury.

Vacuum gauge.

Two suitable pans with handles, 3-liter (3-quart) size, approximately 100 mm (4 inches) deep.

Infra-red drier, oven, or hot plate.

250-mm (10-inch) diameter funnel cut-off to small end diameter of 125 to 150 mm (5 to 6 inches).

Accessories, including thermometers, wash bottle, beakers, pan, rubber tubing, neobrene rubber gloves, etc.

Supply of:

Filter paper (E-D grade 615).

20 liters (5 gallons) alternate solvent.

Diatomaceous silica.

Clean, heavy wrapping paper.

Computation sheets for field extraction procedure.

Cartons for shipping samples.

9-3.1K Paint

Wet film thickness gauge.

Sample cans, 500 ml or 1 liter (pints or quarts).

Surface Thermometer.

Sling psychrometer.

Dew point chart.

Dry film thickness gauge.

9-3.2 Test Methods for Materials

Wherever designated, the test method as specified by WSDOT Laboratory Manual will be used to perform testing. These test methods are included, in numerical order, in Chapter 9-8 of this manual.

9-3.2A Test Methods for Aggregates

9-3.2A(1) Quartering Samples

Use WSDOT Test Method 116 — Method for Reducing Field Samples of Construction Materials to Testing Size.

9-3.2A(2) Screening Coarse Aggregate

Use WSDOT Test Method 104 — Method of Test for Sieve Analysis of Fine and Coarse Aggregates.

9-3.2A(3) Screening Fine Aggregate

Use WSDOT Test Method 102 — Method of Test for Aggregate Finer than the 0.075 mm (U.S. No. 200) sieve.

9-3.2A(4) Determining Percentage of Fracture

Use WSDOT Test Method 103 — Method for Determining Percentages of Fracture in Aggregates.

9-3.2A(5) Moisture in Concrete Aggregates

Tests for moisture in concrete aggregate should be designed to measure the free water, exclusive of the absorbed water.

Coarse Aggregate: The percentage of water in coarse aggregate should be determined on a sample of about 45 kilograms (100 pounds) carefully weighed to the nearest 0.1 kilogram ($^1/_4$ pound). Dry the sample at room temperature to avoid driving off the absorbed water. Spread out in a thin layer and stir occasionally. Preliminary wiping of individual pieces with a dry cloth will materially reduce the time required for drying. As soon as the surface film of moisture has evaporated from substantially all pieces, weigh the sample to the nearest 0.1 kilogram ($^1/_4$ pound). Record the percentage of water as the loss in mass (weight) due to drying multiplied by 100, divided by the air-dry mass (weight), and expressed to the nearest 0.2 percent.

Fine Aggregate: The percentage of water in fine aggregate should be determined on a sample of 500 grams weighed to the nearest gram. Heat may be used for the first part of the drying but the final evaporation must take place from sand at room temperature. As the sample is reaching the final stages of drying, roll it back and forth on a piece of paper. The end point of drying is reached when the individual

particles cease to cling together and just before the dark color due to a moisture film disappears. Weigh immediately to the nearest gram. Record the percentage of water as the loss in mass (weight) due to drying multiplied by 100, divided by the air-dry mass (weight), and expressed to the nearest 0.2 percent.

Fine Aggregate, Pycnometer Test: See WSDOT Test Method 117 — Method for Determination of Moisture Content of Fine Aggregates — Pycnometer Procedure.

9-3.2A(6) Bulk Specific Gravity

Bulk specific gravity is defined as the ratio of the mass (weight) of a given volume of a material including all voids contained within the particles to the mass (weight) of an equal volume of water. Bulk specific gravity may be reported on the basis of the mass (weight) of oven-dry material or on a saturated, surface-dry basis. The latter value is always given in reports from the laboratory since it is basically correct in calculating concrete mix proportions.

If the values for bulk specific gravity of the fine and coarse concrete aggregates to be used on the job as determined by the laboratory are not known, submit 2.5 kilograms (5 pounds) of fine aggregate or 7 kilograms (15 pounds) of well graded coarse aggregate with the request that this determination be made. The specific gravity of material from any pit is reasonably constant so that once it has been determined, new determinations need not be made. When a letter of approval is issued, the bulk specific gravity will be reported if known.

It is possible to make a rapid test for free water in sand provided its bulk specific gravity is known. The latter may be determined in the field if care is taken in performing the steps outlined below. It is preferred, however, that the values reported by the laboratory be used whenever they are available.

See WSDOT Test Methods 107, 108 and 118 — Methods of test for determining the bulk specific gravity and absorption of coarse and fine aggregates.

9-3.2A(7) Colorimetric Test for Organic Matter

See WSDOT Test Method 111 — Method of Test for Organic Impurities in Sands for Concrete.

If the color is as dark or is darker than the glass plate, the sand is open to suspicion. The organic matter may or may not be harmful. The effect can only be determined by testing the strength developed in mortar or concrete. The laboratory has records of certain pits in which the dark color is harmless. If the behavior of the sand in question is not known, the proper procedure is to reject for dark color until strength tests can be made. Notify the Materials Engineer at once when this situation arises.

9-3.2A(8) Particles of Specific Gravity Less Than 1.95

It may be necessary to make this test in the field on certain occasions. In this event, equipment and instructions will be furnished by the laboratory.

9-3.2B Test Methods for Portland Cement Concrete

9-3.2B(1) Test Cylinders

Use WSDOT Test Method 809 — Method of Making, Handling, and Storing Concrete Compressive Test Specimens in the Field.

9-3.2B(2) Slump Test

Use WSDOT Test Method 804 — Method of Test for Slump of Portland Cement Concrete.

9-3.2B(3) Entrained Air in Concrete

Use WSDOT Test Method 805 — Method of Test for Determination of Percent of Entrained Air in Portland Cement Concrete.

9-3.2B(4) Concrete Test Beams

Use WSDOT Test Method 808 — Method for Making Flexural Test Beams. Use WSDOT Test Method 802 — Method of Test for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading).

It will be the policy to make and test beams on all portland cement concrete paving jobs.

9-3.2B(5) Density and Cement Factor of Concrete Mix

Use WSDOT Test Method 806 — Portland Cement Concrete Mass per Cubic Meter (Foot) Cement Factor.

9-3.2C Sand Equivalent Test for Paving and Surfacing Materials

Use WSDOT Test Method 109 — Sand Equivalent Test for Surfacing Materials.

Frequency of Testing: The sand equivalent test will be made at the frequency outlined in Chapter 9-5.7 of this manual. There are conditions, however, when it should be made more frequently. These are: at the start of production when the quality of the product is not well established; in the production of gravel base when screen tests are not made frequently; whenever there is a question as to sufficient stripping of the pit; or, when rock quarries carry earthy matter in the joints and seams. Results of sand equivalent tests should be recorded in the Inspector's Record of Field Tests Form 422-020.

Action to be Taken by Project Engineer: When sand equivalents are found that are below the limit specified by the *Standard Specifications* or the contract special provisions, the Project Engineer should immediately send a complete sample to the Regional Materials Laboratory. The accompanying transmittal should include the sand equivalent, test results and request confirming tests. Without waiting for a report from the Region, the Project Engineer must take whatever steps are necessary toward obtaining cleaner material that will meet the specification requirements and shall have sand equivalent tests made at frequent intervals until a product that is satisfactory is being consistently obtained.

The point of acceptance for this test procedure is in the field. Olympia Service Center or Regional Materials Laboratory tests shall be a check on the field test procedures. Regional Materials Laboratory results do not supersede field test results. Should a discrepancy exceeding tolerance limits (±10 points) occur, the Assurance Sampler shall investigate the field procedures immediately to resolve such discrepancies, even to having field techniques standardized to the laboratory equipment.

Only Laboratory-trained and certified personnel will be assigned the task of performing the Sand Equivalent Test. Certification of an individual is made when that individual, using field equipment and like samples, can successively obtain test results equal to those obtained by the Laboratory, within the specified tolerance limits. At least one person from each Project Engineer's crew will normally be assigned to perform the Sand Equivalent Test, as well as the Assurance Samplers, and be trained in the Regional Materials Laboratory and their techniques be standardized to the Region Laboratory Equipment.

9-3.2D Density and Relative Compaction of Soils and Surfacing Materials Using the Nuclear Gauge*

Use WSDOT Test Method 613 — Method for Determining Inplace Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/ Density Gauge.

9-3.2E Density Determination of Asphalt Concrete Pavements Using the Nuclear Gauge*

Use WSDOT Test Method 715 — Method of Test for Relative Compaction of Asphalt Concrete Pavements Using the Nuclear Gauge.

***Note:** See Chapter 9-6 of this manual for guidance for personnel using and administering the use of the Nuclear Gauge.

9-3.2F Vacant

9-3.2G Moisture Determination

9-3.2G(1) Moisture Determination, Oven Drying Method

Use WSDOT Test Method 106 — Method of determination of Moisture Content in Aggregates by Oven Drying.

9-3.2G(2) Moisture Determination, Field Stove Method

A gasoline or alcohol field stove can be used to furnish dry heat. However, caution must be used to avoid overheating the sample.

Accuracy: Similar to alcohol method.

Time: 10-30 minutes.

9-3.2H Field Sampling of Asphalt Mixtures

Use WSDOT Test Method 712 — Standard Method of Sampling Bituminous Paving Mixtures.

9-3.2I Degree of Particle Coating "Ross Count"

Use WSDOT Test Method 714 — Determining Degree of Particle Coating of Bituminous Aggregate Mixtures "Ross Count." Section 5-04.3(8) of the *Standard Specifications* requires that mixing time be sufficient to produce 95 percent coated particles as determined by WSDOT Test Method No. 714. The results of this test are also referred to as a "ross count" and the Inspector records the test results on Form 422-002.

9-3.2J Quick Extraction Method

Use WSDOT Test Method 723 — Quick Method for the Determination of Aggregate Gradation Using Alternate Solvent.

9-3.2K Determination of Asphalt Content

WSDOT Test Method 722 — Determination of Asphalt Content by the Nuclear Method.

9-3.2L Moisture in Bituminous Paving Mixtures

Use WSDOT Test Method 713 — Method for Determining Moisture in Bituminous Paving Mixtures.

9-3.2M Maximum Specific Gravity of Bituminous Paving Mixtures "Rice Density"

WSDOT Test Method 705 — Maximum Specific Gravity of Bituminous Paving Mixtures — "Rice Density."

9-3.2N Moisture Density Relations of Soil

Use WSDOT Test Method 609 — Method of Test for Moisture Density Relations of Soil.

9-3.2O Maximum Density Determination (Granular Soils)

Purpose of Test

The maximum density test is performed in order to provide the Engineer with a density standard for controlling compaction of predominantly granular soils and surfacing materials.

Types of Materials for Test

This test was developed for granular soils which are not suited to the standard moisture density test. With granular soils, especially free draining ones, the density is affected more by variations in grading than by variations in moisture content. A maximum density curve should be obtained for each type of granular embankment soil or surfacing material to be used on a project.

Test Samples

A 50-kilogram (100-pound) sample of material is required for each test. The sample should be from an approved source set up for the project and should be submitted to the Regional Materials Laboratory with a control sample letter.

Test Results

The test results are reported in the form of a curve where density is plotted against grading (percent passing the 4.75 mm (U.S. No. 4) sieve). The maximum density for any particular grading (percent passing the 4.75 mm (U.S. No. 4) sieve) may be determined from this curve by reading the ordinate of the intersection of the curve with the "Percent passing" value.

Equipment Required for Test

No field equipment is required for this test inasmuch as it is performed only at the Olympia Service Center Materials Laboratory or in the Regional Materials Laboratory. At least one week is required to process and report out a sample.

9-4 Specific Requirements for Each Material

9-4.1 Portland Cement or Blended Hydraulic Cement

1. Approval of Source: Request approval of the manufacturing plant and supplier of cement for each project.

2. Preliminary Samples: A preliminary sample for prequalification of a source will be required only if requested on the Request for Approval of Material Sources Form 350-071.

3. Acceptance:

   a. Bulk cement will be accepted upon receipt of a Manufacturer's Mill Test Report number which shall be reported on each certified concrete delivery ticket.

   b. Bagged cement will be accepted by "SATISFACTORY" test reports from the Olympia Service Center Materials Laboratory. Acquire a 5-kilogram (10-pound) sample from one of every 400 bags and ship to the Laboratory for testing. Allow a minimum of 10 days from receipt of the sample at the Laboratory for testing. DO NOT permit the use of bagged cement until an acceptance report has been received from the Laboratory.

4. Verification: Production mills will provide samples directly to the Olympia Service Center, Materials Laboratory on a quarterly basis to compare with the producers mill test report. The Engineer may take samples for testing as described in *Standard Specifications* Section 9-01.3.

Specification Requirements: See *Standard Specifications* Section 9-01. Review contract documents to determine if supplemental specifications apply.

9-4.2 Asphalt Road Materials

1. Approval of Source: Approval of source is required before use. In requesting approval, give name of company and point from which shipments are to be made.

2. Preliminary Samples: Preliminary samples will not be required.

3. Acceptance: Asphalt may be used after receipt of approval of source if the shipment is accompanied by Form 350-053, "Notice of Asphalt Shipment" or the asphalt shippers Bill of Lading with the information required by the *Standard Specifications*." Examine these certificates to make sure the material is of the grade required and that it comes from the approved source. If material is received which does not have this notice, a sample shall be taken from the load, and shipped to the Olympia Service Center Materials Laboratory at once, with a request for immediate testing.

4. Verification: Samples for verification of specification conformance will be taken based on shipments (truck and trailer) to the project. The samples will be taken in duplicate by the Project Engineer and both of them forwarded promptly to the Laboratory.

Liquid asphalts (emulsions and cutbacks) shall be sampled from every other shipment. Emulsion used for tack coat for ACP does not require sampling. Paving asphalts (AR4000W, AR and AC grades, PBA grades) shall be sampled from every third shipment.

Samples shall be taken as close as possible to the point where the material is to be used; i.e., pug mill, distributor, etc. In the case of cut-back asphalts, this may be from the distributor itself, by opening a valve or one of the nozzles. If a hand nozzle is available, the sample may be drawn off there. Paving asphalts for use in a plant should be sampled by drawing from the line to the pug by means of a valve from the line.

Specifications require the Contractor to install such a valve. In all cases where the sample is taken from a hose or valve, sufficient material must be drawn off before taking the sample to ensure that the sample is representative of the material being used.

If samples cannot be taken from the distributor or the supply line, as outlined above, they may be taken from the storage tank. Samples from large tanks must be taken with a "thief," so that they do not include surface material, but are from near the middle of the material in storage. They may be taken by the grab method — that is, the full amount of the sample will be taken at one time or at one spot in the car.

Samples of emulsified asphalts shall also be taken as close as possible to where the materials is used, but they must be taken before any dilution of the material on the job.

It may be difficult to relate the certificate number from the "Notice of Asphalt Shipment" to the sample under this procedure. It is requested, however, that, as closely as possible, the stations where the material was used be shown on the control sample letter accompanying the sample.

Because the entire sample may be used in testing, it is necessary to have a reserve sample in case the material is found not to comply with the specifications. Therefore, every sample is to be taken in duplicate and forwarded to the Olympia Service Center Materials Laboratory for testing.

The containers for all liquid products except emulsions will be approximately 1-liter (1-quart) cans with 44-mm ($1^3/_4$-inch) screw caps. Containers for emulsions will be plastic. While these may seem unnecessarily difficult to fill they are the only type that can be handled conveniently in the Laboratory. Always use new, clean containers that are free of rust, dents, or other weaknesses that may cause leaking or contamination. Containers previously used for any other purpose will not be satisfactory regardless of how well cleaned they are considered to be. The outside of the containers must not be cleaned by immersion in kerosene or other solvent because of the danger of contaminating the sample. Containers must not be cooled by immersion in water or other liquid as contraction may draw contaminants into sample. Solid asphalts may be shipped in the above cans or in any clean metal container found convenient. Enter complete data on gummed label Form 350-028 and attach to can. Complete a sample transmittal, Form 350-056, and attach it, in its envelope, to the can.

Also mail a letter of transmittal on Form 350-056.

5. Field Inspection: Check truck-tanks for separation into lighter and heavier components. Check temperature to which material is heated to make sure specified limits are not exceeded. Check truck-tanks after unloading to make sure they are empty.

6. Specification Requirements: See *Standard Specifications* Section 9-02. Review contract documents to determine if supplemental specifications apply. In addition, refer to project mix design.

9-4.3 Asphalt for Subsealing

1. Approval of Source: Approval of source is required before use.

2. Preliminary Samples: Preliminary samples are required as noted in (3) below.

3. Acceptance: Asphalt will not be used prior to test report from the Laboratory showing shipment to be satisfactory. This report will be based on sample taken at refinery.

4. Assurance: Samples are not required unless specifically requested by the Olympia Service Center Materials Laboratory.

5. Field Inspection: Check against damage by overheating.

6. Specification Requirements: See *Standard Specifications* Section 9-02. Review contract documents to determine if supplemental specifications apply.

9-4.4 Concrete Aggregates

1. Approval of Source: Approval of source is required for each pit. A preliminary sample must be submitted from all sources that have not had Steilacoom comparison tests run in the past 10 years, if not, approval will be limited to producer design mixes only.

2. Preliminary Samples: See chapter on Sampling for instructions on securing preliminary samples. Ship samples in tight canvas or burlap sacks. If material appears to be

reasonably uniform in composition and will wash clean, send 150 kilograms (300 pounds) of pit run material or 30 kilograms (60 pounds), if sand only. If material is found in the laboratory to be of doubtful quality, additional samples, up to 200 kilograms (500 pounds), may be requested.

3. Acceptance: After the source has been approved, concrete aggregates may be accepted upon satisfactory field tests for grading, cleanliness and freedom from excessive organic matter, silt, and soft or foreign pieces.

Acceptance samples shall be obtained, tested, and recorded in accordance with the *Standard Specifications*, the contract special provisions, and Chapters 9-5, and 10-3.14A of this manual.

4. Assurance: 25-kilogram (50-pound) samples of coarse aggregate and 3-kilogram (5-pound) samples of fine aggregate are required. The persons responsible for obtaining the samples and the number of samples required are shown in Chapter 9-5 of this manual.

Do not use heat to dry samples for submission to the laboratory. See chapters on Sampling Methods and Testing.

Assurance samples will not be required if total quantity of concrete in the contract is less than 80 cubic meters (100 cubic yards).

5. Field Inspection: Make tests enumerated above under "Acceptance" as required. See chapters on Sampling Methods and Testing. Discuss test results with the Contractor's representative. Enforce provisions of the *Standard Specifications*, regarding storing and draining of aggregates.

6. Specification Requirements: See *Standard Specifications* Section 9-03.1 and 3-02. Review contract documents to determine if supplemental specifications apply.

9-4.5 Surfacing Aggregates (Crushed Screening, Crushed Cover Stone, Ballast, Shoulder Ballast, Crushed Surfacing Base and Top Course)

1. Approval of Source: Approval of source is required for each type of aggregate for each pit used.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071. A preliminary sample must be submitted for all sources that have not had qualifying tests run in the past 10 years. See Chapter 9-2 on Sampling Methods for instructions for taking samples.

3. Acceptance: See Chapter 9-5.7 of this manual for testing frequency and elements, such as gradation, sand equivalent for which acceptance testing must be preformed prior to use of the material.

4. Assurance: Samples are required at the frequency shown in Chapter 9-5.7 of this manual. See Chapter 9-2.5 of this manual for the size of sample required.

5. Field Inspection: See chapters on Sampling Methods and Testing. Discuss test results with the Contractor's representative. Enforce provisions of the *Standard Specifications* regarding stockpiling.

6. Specification Requirements: See *Standard Specifications* Sections 3-02, 9-03.4, and 9-03.9. Review contract documents to determine if supplemental specifications apply.

9-4.6 Aggregates for Asphalt Concrete and Asphalt Treated Base

1. Approval of Source: Approval of source is required for each pit or quarry. A preliminary sample must be submitted for all commercial pits that have not had quality tests run in the past 10 years. Blending sand used in asphalt mixtures, affects the quality of the mixture to an extent that is greatly out of proportion to its percentage in the total mixture. Approval of source of blending sand is as important as for the remaining aggregate. A minimum of 10 days is required in the laboratory for testing preliminary samples of aggregates for asphalt concrete and plant mix, including blending sand. Warn the contractor of the time required for testing.

(2-a) Preliminary Samples: See Chapter 9-2, Sampling Methods, for instruction for securing preliminary samples. Ship samples in tight canvas or burlap sacks. Send 100 kilograms (200 pounds) of rock or pit run gravel, or 10 kilograms (25 pounds) of sand only. Give full details of type of construction proposed.

(2-b) Job Mix Design Samples: See Chapter 9-2, Sampling Methods, for instructions in securing samples. Send 100 kilograms (200 pounds) of aggregate from each stockpile intended for use on the contract (i.e., 100 kilograms (200 pounds) of 16 mm to 6.3 mm ($^5/_8$ to $^1/_4$) and 50 kilograms (100 pounds) of 6.3-0 mm ($^1/_4$-0)). If blending sand is to be used, a 50-kilogram (100-pound) sample would be adequate. If RAP (Recycled Asphalt Pavement) is used, a 125-kilogram (300-pound) sample should be sent.

These aggregate samples must be accompanied by the following data, as supplied by the contractor: individual stockpile average gradations, proposed combining ratios of aggregate materials, proposed gradation of the completed mix, and the intended source of the asphalt cement.

3. Acceptance: Material may be accepted based on satisfactory field tests as follows: Aggregates produced for use on the same contract shall be sampled and tested for fracture and sand equivalent as the material is placed into stockpile. Acceptance of the aggregate for gradation shall be based on samples taken from the final mix. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalent shall apply at the time of its introduction to the cold feed of the mixing plant.

If the aggregates are being produced for use on a future contract, they shall be sampled and tested for gradation as well as fracture and sand equivalent at the time the material is placed in stockpile.

During production of aggregates, the Inspector may take and test samples to inform the Engineer and the Contractor of the quality and gradation of the material being produced and to obtain mix design samples (see paragraph (5)). The Inspector shall check the box "Information Sample Only" at the top of Form 422-020, "Inspector's Record of Field Tests," and under remarks will not check either the "Satisfactory" or the "Rejected" box, but may add appropriate remarks.

4. Assurance: Samples are required for each 5,000 tonnes (tons) produced. See Chapter 9-2.4 of this manual for the size of sample required.

5. Field Inspection: See chapters on Sampling Methods and Testing. Discuss test results with the Contractor's representative. Enforce provisions of the *Standard Specifications* regarding stockpiling.

6. Specification Requirements: See *Standard Specifications* Sections 3-02, 9-03.6 and 9-03.8. Review contract documents to determine if supplemental specifications apply. AASHTO M 17 or ASTM D 242.

9-4.7 Asphalt Concrete and Asphalt Treated Base

1. Approval of Source: Approval of source as provided by Chapters 9-4.4 and 9-4.14 of this manual is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted on satisfactory field tests for gradation and asphalt content. Acceptance samples shall be obtained, tested and recorded in accordance with the *Standard Specifications*, contract documents and Chapters 9-5 and 10-3.5 of this manual.

4. Assurance: One sample is required for each day's production. Assurance samples are to be split three ways. One-third is tested by the field inspector, one-third is forwarded to the Regional Materials Laboratory and the final third is forwarded directly to the Olympia Service Center Materials Laboratory. The mass (weight) of each sample should be approximately 10 kilograms (25 pounds).

5. Field Inspection: The Project Engineer should perform a plant inspection prior to production. Forms for this purpose are available from the Olympia Service Center Materials Laboratory. The Inspector should see general section on Sampling Methods and Testing. Discuss test results with the Contractor's representative.

6. Specification Requirements: See *Standard Specifications* Sections 5-04, 9-03.6, and 9-03.8. Review contract documents to determine if supplemental specifications apply.

9-4.8 Mineral Filler

1. Approval of Source: Approval of source is required. A preliminary sample must be submitted for all commercially used pits that have not had quality tests run in the past 10 years.

2. Preliminary Sample: Ship 1.5 kilograms (3 pounds) in polyethylene bag.

3. Acceptance: Acceptance of commercial stone dust on satisfactory laboratory tests only for each lot of 50 tonnes (tons) or less. Portland cement may be accepted without test if it is furnished in original factory sacks and is not lumpy.

4. Assurance: Mineral filler must be stocked in identifiable units of not over 50 tonnes (tons) each. Carefully selected samples of 1.5 kilograms (3 pounds) must be shipped to the laboratory in polyethylene bag.

5. Field Inspection: See that the mineral filler does not contain foreign material or lumps.

6. Specification Requirements: See *Standard Specifications* Section 9-03.8(5). Review contract documents to determine if supplemental specifications apply. AASHTO M 17 or ASTM D 242.

9-4.9 Gravel Base and Bank Run Gravel for Trench Backfill

1. Approval of Source: Approval of source is required for each type of aggregate for each pit used.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071. A preliminary sample must be submitted for all sources that have not had qualifying tests run in the past 10 years. See Chapter 9-2 on Sampling Methods for instructions for taking samples.

3. Acceptance: See Chapter 9-5.7 of this manual for testing frequency and elements, such as gradation, sand

equivalent for which acceptance testing must be preformed prior to use of the material.

4. Assurance: Samples are required at the frequency shown in Chapter 9-5.7 of this manual. See Chapter 9-2.5 of this manual for the size of sample required.

5. Field Inspection: See Chapters on Sampling Methods and Testing. Discuss test results with the Contractor's representative. Enforce provisions of the *Standard Specifications* regarding stockpiling.

6. Specification Requirements: See *Standard Specifications* Section 3-02, 9-03.4, and 9-03.9. Review contract documents to determine if supplemental specifications apply.

9-4.10 Pit Run Aggregates (Gravel Backfill for Foundation CL. B, Walls, Pipe Bedding; Backfill for Sand Drains, Sand Drainage Blanket, Gravel Borrow, Select Borrow, Common Borrow, Bedding Material for Rigid Pipe, Flexible Pipe; Foundation Material Class A, B, and C)

1. Approval of Source: Approval of source is required for each type of aggregate for each pit used.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071. See Chapter 9-2 on Sampling Methods for instructions for taking samples.

3. Acceptance: See Chapter 9-5.7 of this manual for testing frequency and elements, such as gradation, sand equivalent for which acceptance testing must be preformed prior to use of the material.

4. Assurance: Samples are required at the frequency shown in Chapter 9-5.7 of this manual. See Chapter 9-2.5 of this manual for the size of sample required.

5. Field Inspection: See Chapters on Sampling Methods and Testing. Discuss test results with the Contractor's representative. Enforce provisions of the *Standard Specifications* regarding stockpiling.

6. Specification Requirements: See *Standard Specifications* Section 3-02, 9-03.4, and 9-03.9. Review contract documents to determine if supplemental specifications apply.

9-4.11 Gravel Backfill for Drains

1. Approval of Source: Approval of source is required. A preliminary sample may be required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: See Chapter 9-5.7 of this manual for testing frequency. The gradation testing must be performed prior to use of the material. If commercially processed concrete aggregate grading number 5 is provided, the test frequency may be reduced from one test per 100 tonnes (tons) to one test per 1,000 tonnes (tons) or fraction thereof, with a minimum of one test per project.

4. Assurance: See Chapter 9-5.7 of this manual for testing frequency.

5. Field Inspection: See that voids are not filled with dirt, clay, etc., during or after placing. The material should not contain soft pieces that may crush or disintegrate. It is improbable that unwashed aggregate will meet the requirements of the specifications.

Do not accept without performing full washed gradation test as required by WSDOT Method 104 Part A.

6. Specification Requirements: See *Standard Specifications* Section 9-03.12(4). Review contract documents to determine if supplemental specifications apply.

9-4.12 Premolded Joint Filler

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Field sampling is not required.

4. Assurance: Samples are not required.

5. Field Inspection: Check for accuracy in cutting, stapling, and care in handling.

6. Specification Requirements: See *Standard Specifications* Section 9-04.1. Review contract documents to determine if supplemental specifications apply.

9-4.13 Expansion Joints and Compression Seals

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on a satisfactory test report.

4. Assurance: Samples not required.

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

6. Specification Requirements: Review contract documents to determine if supplemental specifications apply.

9-4.14 Poured Rubber Joint Sealer

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted on satisfactory test report or lot approval by the Olympia Service Center Materials Laboratory. Submit an unopened kit unless specifically exempted by the Olympia Service Center Materials Laboratory.

4. Assurance: Samples are not required.

5. Field Inspection: Make certain that application is in accordance with requirements of *Standard Specifications* and manufacturer's recommendations. In order to obtain satisfactory adhesion of the sealer, joints must be thoroughly cleaned before the sealer is applied. This is particularly true where joints wider than 30 millimeters ($1^1/_4$ inches) are to be sealed. These joints should be sandblasted just prior to applying the sealer unless the Project Engineer is ABSOLUTELY CERTAIN that the joint surfaces have no trace of curing compound, dirt, oil, grease, or other contaminants.

6. Specification Requirements: See *Standard Specifications* Section 9-04.2(1) and (2). Review contract documents to determine if supplemental specifications apply.

9-4.15 Rubberized Crack Pouring Asphalt (AASHTO M 173) (ASTM D 1190)

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Acceptance Sample testing required prior to use. Submit one box sample to the Olympia Service Center Materials Laboratory and hold use until results are received. If the lot can be identified and proven to have prior satisfactory acceptance test results, it may be used without testing on current projects.

4. Assurance: Samples not required.

5. Field Inspection: Ensure that application is in accordance with requirements of the *Standard Specifications* and the manufacturer's recommendation.

9-4.16 Concrete Culvert, Sewer, Drain, and Underdrain Pipe

1. Approval of Source: Approval of manufacturer is required.

2. Preliminary Samples: Not required.

3. Acceptance:

   a. Concrete pipe less than 750 millimeters (30 inches) in diameter will be accepted based on "Concrete Pipe Acceptance Reports" which shall accompany the pipe to the job. Individual pipe are not stamped.

   b. Concrete pipe 750 millimeters (30 inches) in diameter and larger are individually inspected at the plant prior to shipment. Accepted pipe will be stamped "Approved for Shipment."

4. Assurance: No assurance sampling required.

5. Field Inspection:

   a. Concrete pipe less than 750 millimeters (30 inches) in diameter:

      1) Verify that the "Concrete Pipe Acceptance Report" is current and covers the diameter quantity and class of pipe delivered.

      2) Inspect the manufacture date marked in each pipe to verify that it was made within the period covered by the Inspection Report. Also verify that shipment was made after the required retention time. *Standard Specifications* require 28 days for pipe using Type II cement and seven days for pipe using Type III cement. If tested and accepted at an earlier age these requirements may be modified.

      3) Verify that the pipe is free from damage from handling and shipping.

      4) Complete the upper portion of the "Concrete Pipe Acceptance Report" and forward to the Olympia Service Center Materials Laboratory, Attn: Contract Documentation.

   b. Concrete pipe 750 millimeters (30 inches) in diameter and larger:

      1) Verify that each pipe in the shipment is stamped "Approved for Shipment." Unless properly stamped, pipe should not be accepted.

      2) Verify that pipe is free from damage from shipping and handling.

Concrete sewer pipe requires hydrostatic testing after installation in conformance with the *Standard Specifications*.

6. Specification Requirements: See *Standard Specifications* Section 9-05. Review contract documents to determine if supplemental specifications apply.

7. Final Documentation:

a. Concrete pipe less than 750 millimeters (30 inches) in diameter: "Concrete Pipe Acceptance Reports" must be accumulated to cover the job quantities used. Copies of all such reports must be forwarded to the Contract Documentation Section.

b. Concrete pipe 750 millimeters (30 inches) in diameter and larger: For all pipe inspected and stamped prior to delivery, the Fabrication Inspector will prepare and provide a Concrete Pipe Acceptance Report.

9-4.17 Galvanized Steel, Aluminized Steel and Aluminum Corrugated Metal Culvert, Drain Pipe and Perforated Underdrain Pipe

1. Approval of Source: Not required for fabrication facility listed in the Qualified Products List (QPL). For a fabrication facility not listed, approval of the fabrication facility as well as the base metal must be obtained.

2. Preliminary Samples: Not required.

3. QPL Acceptance: Untreated metal culvert and drain pipe may be accepted at the job site from pipe provided by a manufacturer listed in the QPL. If the pipe shipment does not identify the pipe manufacturer, a shipping Bill of Lading should be requested prior to accepting or installing the pipe. Pipe delivered without the appropriate AASHTO specification for the steel sheet, gauge thickness, and heat number stamped on the pipe, shall not be installed. Record heat numbers for each pipe installation. Any pipe which is damaged in any way from shipping or handling should not be accepted until corrective action is taken. Contact the Olympia Service Center Materials Laboratory.

4. Non-QPL Acceptance:

a. Treated metal culvert pipe will be inspected at the point of fabrication by the Fabrication Inspection Office. A representative number of pipes in each shipment will display "WSDOT Approved for Shipment" tags. If none of the pipe bears the "WSDOT Approved for Shipment" tag, contact the Fabrication Inspection Office to arrange for an on-site inspection prior to installation.

b. Untreated metal culvert and drain pipe provided by a manufacturer not listed in the QPL may be accepted at the job site under the following conditions:

(1) Source approval granted by the Olympia Service Center Materials Laboratory for pipe fabrication and steel sheet.

(2) Facilities inspection performed by the Fabrication Inspection Office if required on Approval of Source.

(3) Manufacturer's Certificate of compliance with supporting Mill Test Reports provided prior to installing pipe.

5. Assurance Samples are not required.

6. Field Inspection: Check each delivery for fabrication details and quality of workmanship. Check for shipping damage and ensure that the spelter coating is intact. Check treated pipe for damage to coating.

Obtain documentation for all pipe not accepted under provisions established in the QPL. Contact the Olympia Service Center Materials Laboratory for assistance.

7. Specification Requirements: See *Standard Specifications* Section 9-05. Review contract documents to determine if supplemental specifications apply.

9-4.18 Perforated Underdrain Pipe

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required unless requested on Request for Approval of Material Sources Form 350-71.

3. Acceptance: After the source has been approved, pipe may be accepted on manufacturer's certification and field inspection.

4. Assurance: Samples are not required.

5. Field Inspection: Check for compliance with specifications, particularly the size and spacing of holes, and for shipment and handling damage.

6. Specification Requirements: See *Standard Specifications* Section 9-05.2(3). Review contract documents to determine if supplemental specifications apply.

9-4.19 Structural Plate Pipes and Arches

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Acceptance may be on the basis of Manufacturer's Certificate of Compliance, with accompanying mill test reports.

4. Assurance: Samples are not required, unless samples of the nuts and bolts are requested on the approval of source.

5. Field Inspection: Check for breaks in spelter or asphalt coating and for damage from shipment.

Material in the shipment must be properly identified as to heat number. The certification discussed above must

accompany the shipment and must contain the information which is listed hereinafter.

a. Chemical analysis of the base metal of each heat number in the shipment.

b. The mass (weight) of spelter coating for each heat number in the shipment.

c. A statement that all materials conform to requirements of the specifications.

d. The certification must be on company letterhead and signed by a responsible company official whose title shall be indicated.

All suppliers of structural plate pipe and arches are to transmit four copies of the certification to the Project Engineer. At least one copy must accompany the shipment; the others may be forwarded through the Contractor. Two copies of the certification are to be retained in the Project Engineer's files; two are to be forwarded by the Project Engineer to the Olympia Service Center Materials Laboratory, together with a description of the material and the quantities involved.

6. Specification Requirements: See *Standard Specifications* Section 9-05.6. Review contract documents to determine if supplemental specifications apply.

9-4.20 Gray-Iron Castings, Steel Castings, Ductile-Iron Castings

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Acceptance will be based on Inspected Items Tag. All castings will be stamped or tagged "APPROVED FOR SHIPMENT" by the shop Inspector.

4. Assurance: Samples are not required.

5. Field Inspection: Check for defects listed in the *Standard Specifications*. Check for the Inspector's approved stamp or tag.

6. Specification Requirements: See *Standard Specifications* Sections 9-05.15, 9-06, and 9-22.1. Review contract documents to determine if supplemental specifications apply.

9-4.21 Sanitary Sewers

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted in lieu of sampling upon receipt of an "APPROVED" document as shown below:

a. Ductile Iron Sewer Pipe — Manufacturer's Certificate of Compliance.

b. Plain Concrete Storm Sewer Pipe — Concrete Pipe Acceptance Report.

c. Reinforced Concrete Storm Sewer Pipe — Concrete Pipe Acceptance Report.

d. Vitrified Clay Sewer Pipe — Manufacturer's Certificate of Compliance.

e. PVC Sewer Pipe — Manufacturer's Certificate of Compliance.

f. Ductile Iron Sewer Pipe — Manufacturer's Certificate of Compliance.

g. ABS Composite Sewer Pipe — Manufacturer's Certificate of Compliance.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check material delivered to the project for damage, and conformance to the contract documents.

6. Specification Requirements: See *Standard Specifications* Section 7-17. Review contract documents to determine if supplemental specifications apply.

9-4.22 Steel for Bridges

1. Approval of Source: Approval of the fabricator as well as the manufacturer of the steel is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Materials and fabrication will be accepted on Inspected Items Tags except in the case of minor parts. As soon as the fabricator receives the materials, the shop Inspector will check the accompanying mill test certificates to ensure the materials meet contract requirements. He will also provide weekly written shop inspection reports to the Project Engineer while major steel structures are being fabricated.

4. Assurance: Samples will not be required. The fabrication Inspector will be in contact with the mill producing the materials and will make arrangements to witness physical tests, including Charpy V-Notch tests when required.

5. Field Inspection: Check for "Approved for Shipment" tags or stamps and shipping and handling damage.

6. Specification Requirements: See *Standard Specifications* Sections 6-03 and 9-06. Review contract

documents to determine if supplemental specifications apply.

7. Plant Inspection: Upon receipt of the "Approval of Source," the Olympia Service Center Materials Laboratory will inspect the fabrication shop to ensure it meets all contract requirements. A copy of the Approval of Source will be sent to the fabrication Inspector.

9-4.23 Unfinished Bolts, Nuts, and Washers

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Unfinished bolts, nuts, and washers may be accepted on receipt of Manufacturer's Certificate of Compliance.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check each lot of material delivered to the project for damage, and that accompanying Manufacturer's Certificate of Compliance is present.

6. Specification Requirements: See *Standard Specifications* Section 9-06.5(1). Review contract documents to determine if supplemental specifications apply.

	Specification Reference
Bolts	ASTM A 307
Nuts	ASTM A 563 AASHTO M 291

9-4.24 High Strength Bolts

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not Required.

3. Acceptance: Material may be accepted on receipt of satisfactory test report from the Olympia Service Center Materials Laboratory. When the material is received on the job site, sample each shipment of the bolts in accordance with the table in Section 9-06.5(3) of the *Standard Specifications*.

4. Assurance: Samples not required.

5. Field Inspection: Make certain that material to be used is from a lot represented by acceptance samples.

6. Specification Requirements: See *Standard Specifications* Section 9-06.5(3). Review contract documents to determine if supplemental specifications apply.

	Specification Reference	
Bolts	AASHTO M 164M	ASTM A 325
	AASHTO M 253M	ASTM A 490
Nuts	AASHTO M 291M	ASTM A 563
	AASHTO M 292M	ASTM A 194
Washers	AASHTO M 293M	ASTM F 436

9-4.25 Anchor Bolts for Luminaires, Signal Poles, and Sign Structures

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualification of a source will be required only if requested on the Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance may be based on "Approval for Shipment" tags.

4. Assurance: Samples are not required.

5. Field Inspection: Check for "Approved for Shipment" tags. Check for damage due to shipping and handling.

Note: Special attention shall be placed on the proper installation of bolts. No adjustments (bending) of bolts will be allowed after placement in concrete.

6. Specification Requirements: See *Standard Specifications* Section 9-06.5(4). Review contract documents to determine if supplemental specifications apply.

9-4.26 Reinforcing Bars for Concrete

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: May be required if requested on Request for Approval of Material Sources Form 350-71.

3. Acceptance: Acceptance will be by the Certification of Compliance and Certified Mill Test reports that will accompany each shipment.

Note: If Mill Test reports are not available, do not incorporate steel into the project and contact the Olympia Service Center Materials Laboratory for guidance.

4. Assurance: Representative of the Olympia Service Center Materials Laboratory will take random samples at the point of fabrication.

5. Field Inspection: Check for Certification of Compliance and Certified Mill Test Reports for sizes and heats of rebar. Remove excess rust and mill scale before

using. Check steel fabrication and bends for compliance with plans and specifications.

6. Specification Requirements: See *Standard Specifications* Section 9-07. Review contract documents to determine if supplemental specifications apply. AASHTO M 31M or ASTM A 615.

9-4.27 Epoxy Coated Reinforcing Steel Bars for Concrete

1. Approval of Source: Approval of source is required for both the steel supplier and the epoxy coating applicator.

2. Preliminary Samples: A preliminary sample for pre-qualification of a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on "APPROVED FOR SHIPMENT" stamp or tag.

Note: If bar is not tagged "APPROVED FOR SHIPMENT" do not incorporate steel into the project and contact the Olympia Service Center Materials Laboratory for guidance.

4. Assurance: Representatives of the Olympia Service Center Materials Laboratory will take random samples at the point of fabrication and at the coating facility.

5. Field Inspection: Check shipment for "APPROVED FOR SHIPMENT" stamp or tag. Check coating for shipping damage, check steel fabrication, and bends for compliance with plans and specifications.

6. Specifications Requirements: See *Standard Specifications* Section 9-07. Review contract document to determine if supplemental specifications apply.

9-4.28 Rebar Splices

1. Approval of Source: Approval of source is required.

2. Preliminary Sample: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of a "SATISFACTORY" Test Report from the Olympia Service Center Materials Laboratory from samples taken from the project. A Manufacturer's Certificate of Compliance and other technical data MUST be submitted with the samples.

4. Verification: Sample per Section 6-02.3(24)G of the *Standard Specifications.*

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

6. Specification Requirements: See *Standard Specifications* Section 6-02.3(24)F and G. Review contract documents to determine if supplemental specifications apply.

9-4.29 Rebar Chairs, Dobies, and Spacers

1. Approval of Source: Approval of source is required.

2. Preliminary Sample: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of Manufacturer's Certificate of Compliance. Dobie blocks shall be accepted based upon tests reports for two 50-mm × 100-mm (2-inch × 4-inch) concrete cylinders for each production run of 2,500 blocks or fraction thereof. Cylinders are to be made from the same concrete as the mortar blocks and cured with the mortar blocks.

4. Assurance: Samples not required.

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

6. Specification Requirements: See *Standard Specifications* Section 6-02.3(24)C. Review contract documents to determine if supplemental specifications apply.

9-4.30 Dowels for Concrete Pavement

1. Approval of Source: Approval of source is required.

2. Preliminary Sample: A preliminary sample of two dowels will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance may be on Manufacturer's Certificate of Compliance with accompanying Mill Test Reports.

4. Assurance: Samples are not required.

5. Field Inspection: Check for dimensional conformance and if proper mill test certificates have been provided.

6. Specification Requirements: See *Standard Specifications* Section 9-07. Review contract documents to determine if supplemental specifications apply.

9-4.31 Wire Mesh for Concrete Reinforcement

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: May be required if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance will be by the Certification of Compliance and Certified Mill Test Reports that accompany each shipment.

4. Assurance: Samples are not required.

5. Field Inspection: Check for excessive rust, and for spacing of wires and mass (weight) per square meter (yard) if covered in the special provisions.

6. Specification Requirements: See *Standard Specifications* Section 9-07.7. Review contract documents to determine if supplemental specifications apply.

9-4.32 Bridge Approach Slab Anchors

1. Approval of Source: Approval of source is required.

2. Preliminary Sample: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of Manufacturer's Certificate of Compliance.

4. Assurance: Samples are not required.

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

6. Specification Requirements: See *Standard Plans*. Review contract documents to determine if supplemental specifications apply.

9-4.33 Prestressing/Post Tensioning Reinforcement — Strand

1. Approval of Source: Approval of manufacturer is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance will be on satisfactory laboratory test report only. Submit one sample (minimum of 2 meters (5 feet) in length) from each reel or pack. A copy of a Manufacturer's Certificate of Compliance with supporting test report and stress/strain curve is to accompany each sample submitted for testing.

4. Assurance: Samples are not required.

5. Field Inspection: Check for dirt, grease or rust.

6. Specification Requirements: See *Standard Specifications* Section 9-07.10. Review contract documents to determine if supplemental specifications apply.

9-4.34 Prestressing/Post Tensioning Reinforcement — Bar

1. Approval of Source: Approval of manufacturer is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance will be on satisfactory laboratory test report only. Send two samples from each heat. The samples must be a minimum of 2 meters (5 feet) in length. A copy of the Manufacturer's Certificate of Compliance shall accompany each heat of reinforcing bar. Additional samples of two bars from each heat if supplement requirements apply.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check material delivered to the project for damage, and conformance to the contract documents.

6. Specification Requirements: Review contract documents to determine specification requirements.

9-4.35 Paints for Structures

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Preliminary Samples will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Paint will be sampled at the point of production and tested by the Olympia Service Center Materials Laboratory prior to its receipt on the project. The lot number on the containers must be checked against the Laboratory test reports. Except as indicated, paint which has not been tested and accepted by the Laboratory will not be used. When less than 80 liters (20 gallons) of one kind of paint are involved, its use without laboratory tests may be approved upon the manufacturer's certificate that the material meets the specification. The certificate shall include a list of materials and the quantities used. One copy of the certificate shall be submitted to the Olympia Service Center Materials Laboratory.

4. Field Samples: Only paint from standard specification formulas C-6-90 and C-9-90 shall be field sampled. Other paints shall be accepted on the basis of a certified lot if applicable. Paint will be sampled on a random basis of one

sample per 400 liters (100 gallons). All paint samples should be taken from the painters buckets. The sample container must be nearly filled and sealed airtight. All paints bearing dates of manufacture over one year old shall be sampled on a basis of one sample per 200 liters (50 gallons).

5. Field Inspection: Determine the mass (weight) per liter (gallon) and compare with the Laboratory test report. Laboratory test reports show the mass (weight) per liter (gallon) at time of acceptance. Appreciable variation from this mass (weight) after arrival on the job is an indication of contamination.

The mass (weight) per liter (gallon) of the paint shall be determined on a random sampling basis by filling a 4-liter (1-gallon) pail to the point where the paint touches the bottom of the inner lip, with paint taken from the top of a container of thoroughly mixed paint, and weighing it to the nearest gram (tenths of a pound) on a market-type scale.

See that paint is not caked in the container, that it is free from skins and is well stirred before withdrawing portions for use.

Paint that has become lumpy during use should be strained through cheesecloth. During cold weather the paint can be made thinner by placing the container in warm water.

After application the paint should dry to a uniform film without running, streaking or sagging.

6. Specification Requirements: See *Standard Specifications* Section 9-08. Review contract documents to determine if supplemental specifications apply.

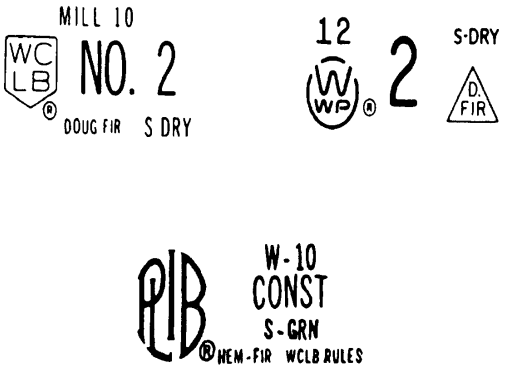
9-4.36 Structural Timber and Lumber — Untreated

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance:

   a. Permanent structures and sign posts 6 x 6 and larger require a Manufacturer's Certificate of Compliance (i.e., Lumber Grading Certificate) conforming to the requirements of the *Standard Specifications*. The Manufacturer's Certificate of Compliance will be issued by the grading bureau whose authorized stamp is being used, or by the mill grading the timber or lumber under the supervision of one of the following lumber grading agencies: West Coast Lumber Inspection Bureau (WCLIB), Western Wood Products Association (WWPA), or the Pacific Lumber Inspection Bureau (PLIB). A typical lumber grade stamp as used by the various inspection agencies are shown below:



   b. Sign posts less than 6 × 6, mileposts, sawed fence posts, and mailbox posts will be accepted by visual determination in the field that each post is stamped with the correct lumber grade.

The PLIB graded lumber will be graded under the grading rules of one of the other two listed agencies and will be grade stamped accordingly.

All timber and lumber is subject to reinspection upon delivery to the project.

4. Assurance: Samples not required.

5. Field Inspection: Check for compliance with specifications.

6. Specification Requirements: See *Standard Specifications* Section 9-09. Review contract documents to determine if supplemental specifications apply.

9-4.37 Treated Timber and Piling

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance:

   a. Permanent structures, sign posts 6 × 6 and larger. Check for inspector's stamp or tag. Acceptance for shipment stamp consists of a circled "WSDOT," or "WHD." Accepted for shipment tags will be stapled to the ends of the pilings or timber. All piling will be stamped or tagged on the butt end. Only about one-third of the approved timber pieces will be stamped or tagged for acceptance. All rejected timber pieces will always be marked with a circled "X."

   b. Sign posts less than 6 × 6, mileposts, sawed fence posts, and mailbox posts except as listed under 9-4.36.

4. Assurance: Samples not required.

5. Field Inspection: Check primarily for damage caused by handling. Check pieces for inspector's stamp or tag.

6. Specification Requirements: See *Standard Specifications* Sections 9-09 and 9-10. Review contract documents to determine if supplemental specifications apply.

9-4.38 Piling — Untreated

1. Approval of Source: Approval of source is not required.

2. Preliminary Samples: Not required.

3. Acceptance: Field inspection.

4. Assurance: Samples not required.

5. Field Inspection: Check for compliance with specifications.

6. Specification Requirements: See *Standard Specifications* Section 9-10.1(1). Review contract documents to determine if supplemental specifications apply.

9-4.39 Steel H-Piling

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Samples are not required unless requested on Approval of Source Form 350-071. Submit a 300 mm (1-foot) section of the piling if requested.

3. Acceptance: Material may be accepted on satisfactory Manufacturer's Certificate of Compliance including mill certificates showing heat number, physical properties and chemical composition.

4. Assurance: Samples are not required.

5. Field Inspection: Check material in each shipment against heat numbers shown on Mill Test Certificates. Check for damage due to shipping and handling.

6. Specification Requirements: See *Standard Specifications* Section 9-10.5. Review contract documents to determine if supplemental specifications apply.

9-4.40 Hollow Steel Piling and Jack Casing

1. Approval of Source: Approval of source is required.

2. Preliminary Sample: Samples are not required unless requested on Approval of Source Form 350-071.

3. Acceptance: Material may be accepted on satisfactory Manufacturer's Certificate of Compliance showing heat number, physical properties, and chemical composition.

4. Assurance: Samples are not required.

5. Field Inspection: Check material in each shipment against heat numbers shown on Mill Test Certificates. Check for damage due to shipping and handling.

6. Specification Requirements: See *Standard Specifications* Section 9-10.5. Review contract documents to determine if supplemental specifications apply.

9-4.41 Precast Concrete Catch Basins, Manholes, and Inlets

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: After the source has been approved, field acceptance will be based on "WSDOT Inspected" stamp or tag provided by the in-plant Materials Inspector.

4. Assurance: Samples not required.

5. Field Inspection: Check for shipping and handling damage and "WSDOT Inspected" stamp or tag.

6. Specification Requirements: See *Standard Specifications* Section 9-12. Review contract documents to determine if supplemental specifications apply.

9-4.42 Stone or Broken Concrete Rubble for Quarry Spalls and Riprap

1. Approval of Source: Approval of source is required for stone.

2. Preliminary Samples: Samples not required unless requested on Approval of Source Form 350-071.

   a. Quality testing for stone shall consist of a 35-kilogram (80-pound) minimum sample (quarry spall sized rock) of unprocessed material from the same area and deposit within the pit as the proposed material. This material shall meet the requirements of Section 9-13 of the *Standard Specifications*.

   Submittal of this sample will not be required if the source has satisfactorily passed the quality test within the preceding 12 months. The Request for Approval of Material Sources, DOT Form 350-071 will reflect the current status of the quarry.

   b. Quality testing for broken concrete rubble shall be as described for stone but may be omitted based on visual examination and discretion of the Project Engineer.

3. Acceptance:

   a. When project quantities for Quarry Spalls are less than 75 cubic meters (100 cubic yards) 200 tonnes (tons) or project quantities for Rip Rap are less than 40 cubic meters (50 cubic yards) (100 tonnes (tons)),

the Project Engineer is delegated acceptance authority for visual determination of Quality of Source

b. When project quantities for Quarry Spalls are between 75 and 400 cubic meters (100 and 500 c.y.) (200 to 1,000 tonnes (tons)) or project quantities for Rip Rap are between 40 and 400 cubic meters (50 and 500 c.y.) (100 to 1,000 tonnes (tons)), the source must have had a satisfactory quality test within the preceding 24 months. The Project Engineer shall determine that the grading is in conformance with the *Standard Specifications* Section 9-13.

c. When project quantities for Rip Rap or Quarry Spalls exceed 400 cubic meters (500 c.y.) (1,000 tonnes (tons)), the source must have had a satisfactory quality test within the preceding 12 months. The Project Engineer shall determine that the grading is in conformance with the *Standard Specifications* Section 9-13.

4. Assurance: Samples are not required.

5. Field Inspection: See that the gradation remains constant.

6. Specification Requirements: See *Standard Specifications* Section 9-13.

9-4.43 Semi-Open Slope Protection

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on the Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of Manufacturer's Certificate of Compliance.

4. Assurance: Samples not required.

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications.

6. Specification Requirements: See *Standard Plans*. Review contract documents to determine if supplemental specifications apply.

9-4.44 Plant Material

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample will be required for all plant material except for trees. Color photographs showing a full view and close-ups and/or cuttings off an individual limb, may be substituted in lieu of the trees if the detail is such that the variety and form can be identified from the photographs and materials furnished.

3. Acceptance: After the approval of the source, the plants may be accepted based on field inspection on the job site. Sample lots as provided in (5), Field Inspection. Field Inspection will be the inspection of the acceptance samples. Acceptable samples will be incorporated into the project.

4. Assurance: Samples not required.

5. Field Inspection: Check for uniformity of plants within each lot and for representative sample lot based on the following:

(N = total number of plants in lot)

(n = number of plants in sample lot)

Total Number of Plants (N)	Minimum No. of Plants required to make sample lot (n)
0 — 20	N
21 — 100	20
101 — 1,000	20 +0.04 (N — 100)
1,001 — 5,000	50 +0.02 (N — 1,000)
5,001 — 30,000	130+0.01 (N — 5,000)
Over 30,000	380+0.005 (N — 30,000)

Should less than 5 percent of the sample lot fail, the entire lot may be accepted. Should over 5 percent of the acceptance sample lot fail to meet nominal specifications requirements, the entire lot shall be rejected and removed from the job, except that, if in the opinion of the Engineer, the lot appears to be exceptionally hearty and vigorous and a large percent might be acceptable after reviewing and sorting by the Contractor. If done immediately, the Contractor shall be allowed to sort and remove the substandard portion of the plants.

After the contractor has completed sorting, a new sample lot based on the above schedule of the remaining stock will again be selected and inspected. Should less than 5 percent of this sample lot fail, the sorted lot may be accepted.

6. Specification Requirements: See *Standard Specifications* Section 9-14. Review contract documents to determine if supplemental specifications apply.

9-4.45 Topsoil Type A

1. Approval of Source: Approval of source is required for Topsoil Type A prior to use.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted upon receipt of a Manufacturer's Certificate of Compliance with accompanying test reports verifying conformance with the Contract Specifications.

4. Assurance: Samples not required.

5. Field Inspection: The material shall be inspected for roots, weeds, subsoil, rocks, and other debris.

6. Specification Requirements: See *Standard Specifications* Section 9-14.1. Review contract documents to determine if supplemental specifications apply.

9-4.46 Seed

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted on analysis shown on the label. Submit a copy of the label with the Erosion Control Report.

4. Assurance: Samples not required.

5. Field Inspection: Each individual sack of seed must contain a label (tag) as to the contents and be unopened prior to use on the project. At least one label should be retained in the project records in the event that subsequent questions or claims may arise.

6. Specification Requirements: See *Standard Specifications* Section 9-14.2. Review contract documents to determine if supplemental specifications apply.

9-4.47 Fertilizer

1. Approval of Source: Approval of sources is required.

2. Preliminary Samples: Not required.

3. Acceptance:

   a. Fertilizer Acceptance: General

   Fertilizer may be accepted based on approval of source and chemical content based on container labels. No fertilizer shall be used from unidentified or unlabeled containers.

   b. Fertilizer for Erosion Control

   The application of fertilizer for erosion control will be in accordance with an erosion control plan which shall be reviewed by and approved by the Project Engineer prior to application. The required elements for the erosion control plan are set forth in the format of the erosion control report.

   For Erosion Control on projects with total quantities less than 2 hectares (5 acres), acceptance of fertilizer may be made by verification of the components based on stamped or printed bag analysis. Projects involving 2 hectares (5 acres) or more shall require a certified analysis of each component furnished meeting the requirements of a Manufacturer's Certificate of Compliance.

   Upon completion of erosion control work, the Project Engineer will provide a summary erosion control report reflecting the materials and amounts applied. A sample format is shown in Figure 9-3.

   c. Fertilizer for Landscaping

   Fertilizer for landscaping projects may be accepted on the basis of examination of the labelled contents for conformance to the project specifications.

4. Assurance: Samples not required.

5. Field Inspection: Each individual sack must be labeled as to its contents which must meet the requirements specified in the special provisions. All bags must be unopened prior to use on the project. Most fertilizers specified contain ureaform (38-0-0) which is blue-green in color which makes that component's presence easy to identify.

6. Specification Requirements: See *Standard Specifications* Section 9-14.3. Review contract documents to determine if supplemental specifications apply.

9-4.48 Mulch

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted as described below for the different types of mulch:

   a. Straw — Visual inspection.

   b. Wood Cellulose Fiber — Manufacturer's Certificate of Compliance.

   c. Bark — Field gradation test.

   d. Sawdust — Visual inspection.

   e. Tackifier — Manufacturer's Certification of Compliance.

4. Assurance: Samples not required.

5. Field Inspection: A visual inspection shall be made to ensure uniformity of the mulch. Also check for detrimental contamination.

6. Specification Requirements: See *Standard Specifications* Section 9-14.4. Review contract documents to determine if supplemental specifications apply.

Erosion Control Report

Contract Number: _____

Date: _____

Contractor: _____

Subcontractor: _____

Inspector: _____

The following materials and rates per hectare (acre) were applied in conformance with the project provisions. Page(s) ____

la) Fertilizer: _____
(Bag analysis is attached)
Application Rate: _____ per hectare (acre)

lb) Fertilizer: _____
(Bag analysis is attached)
Application Rate: _____ per hectare (acre)

lc) Fertilizer: _____
(Bag analysis is attached)
Application Rate: _____ per hectare (acre)

ld) Fertilizer: _____
(Bag analysis is attached)
Application Rate: _____ per hectare (acre)

2) Seed: _____
(Certified analysis is attached)
Application Rate: _____ per hectare (acre)

3) Mulch: _____
Type: _____
Application Rate: _____ per hectare (acre)

4) Tackifier: _____
Type: _____
Application Rate: _____ per hectare (acre)

The above application calculates to be:

Pounds Nitrogen per hectare (acre): _____

Percentage ureaform or ureaformaldehyde: _____

Pounds Phosphorus per hectare (acre): _____

Pounds Potassium per hectare (acre): _____

Pounds Sulfur per hectare (acre): _____

Contractors Signature: _____

Date: _____

Figure 9-3

9-4.49 Irrigation System

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted in lieu of sampling upon receipt of an approved document as shown:

a. PVC Water Pipe — Manufacturer's Certificate of Compliance.

b. Polyethylene Pipe — Manufacturer's Certificate of Compliance.

c. Galvanized Iron Water Pipe — Manufacturer's Certificate of Compliance.

d. Drip Tubing — APPROVED Catalog Cut.

e. Automatic Controllers — APPROVED Catalog Cut.

f. Sprinkler Head — APPROVED Catalog Cut.

g. Valve Boxes and Protective Sleeves — APPROVED Catalog Cut.

h. Gate Valves — APPROVED Catalog Cut.

i. Manual Control Valves — APPROVED Catalog Cut.

j. Automatic Control Valves — APPROVED Catalog Cut.

k. Automatic Control Valves with Pressure Regulator — APPROVED Catalog Cut.

l. Quick Coupling Equipment — APPROVED Catalog Cut.

m. Drain Valves — APPROVED Catalog Cut.

n. Hose Bibs — APPROVED Catalog Cut.

o. Cross-Connection Control Devices — APPROVED Catalog Cut.

p. Check Valves — APPROVED Catalog Cut.

q. Pressure Reducing Valves — APPROVED Catalog Cut.

r. Three-way Valves — APPROVED Catalog Cut.

s. Flow Control Valves — APPROVED Catalog Cut.

t. Air Relief Valve — APPROVED Catalog Cut.

u. Electrical Wire and Splices — APPROVED Catalog Cut.

v. Detectable Marking Tape — APPROVED Catalog Cut.

w. Wye Strainers — APPROVED Catalog Cut.

4. Assurance: Samples not required.

5. Field Inspector: Check for damage to coatings in shipping and handling. See that damaged areas and field cut threads are protected with an approved coating.

6. Specification Requirements: See *Standard Specifications* Section 9-15. Review contract documents to determine if supplemental specifications apply.

9-4.50 Fencing

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted on receipt of satisfactory test report from the Olympia Service Center or Regional Materials Laboratory. Send acceptance samples as follows:

a. Chain Link Fabric — One sample consisting of three wires across full width of fabric from one of each 50 rolls.

b. Wire Mesh — One 300-mm (12-inch) sample across full width of roll, from one of each 50 rolls.

c. Barbed Wire — One 1-meter (3-foot) piece from one of each 50 spools.

d. Rails and Posts for Chain Link Fence — Sample to consist of one rail or post selected for sampling. Sample one rail or post for each 500.

e. Metal Posts for Wire Fence Line Posts — One complete post with plate for each 500 posts. Corner Posts or brace pots — one complete post per 10 corner or brace posts.

Above samples are to be taken from properly identified lots of material stored at job site. Be sure samples are numbered and properly identified as to Lot when sent to the Laboratory. If first sample fails, two additional samples are to be submitted from same lot. Resamples are to be properly identified as to Lot and referenced to previous Lab No. for first sample.

4. Assurance: Samples not required.

5. Field Inspection: Check for damage to spelter coating on posts, rails, hardware, etc. Weigh an occasional post or column to check against specification requirements.

6. Specification Requirements: See *Standard Specifications* Section 9-16. Review contract documents to determine if supplemental specifications apply.

9-4.51 Beam Guardrail, Guardrail Anchors, and Glare Screen

1. Approval of Source: Approval of source is required. May be approved through Subcontractor Qualification.

2. Preliminary Samples: Not required.

3. Acceptance: Steel rail elements, fittings, terminal sections, hardware, and bolts may be accepted by Qualified Subcontractor's Certification.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check material delivered to the project for damage to galvanizing. Verify quantities against Subcontractor's Certification.

6. Specification Requirements: See *Standard Specifications* Section 9-16.3. Review contract documents to determine if supplemental specifications apply.

7. Procedural letter and typical request for approval are shown in Figures 9-4 and 9-5, following.

9-4.52 Guardrail Posts and Blocks

1. Approval of Source: Approval of source is required through Subcontractor's Qualification.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source, will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on qualified Subcontractor's Certification of completed installation.

4. Assurance: Samples not required.

5. Field Inspection: Check material delivered to the project for conformance with the contract plan and specifications. Verify quantities against Subcontractor's Certification.

6. Specification Requirements: See Standard Plans. Review contract documents to determine if supplemental specifications apply.

9-4.53 Miscellaneous Precast Concrete Products (Including Posts, Markers, and Cribbing)

1. Approval of Source: Approval of source is required unless made on job.

2. Preliminary Samples: Not required.

3. Acceptance: Acceptance on field inspection. In general, the Olympia Service Center Materials Laboratory will not undertake inspection of these products. When large quantities are involved, the Regional Administrator should arrange for inspection during manufacture, including the sampling of materials and the making of test cylinders.

4. Assurance: Samples not required.

5. Field Inspection: Check mix and quality of concrete during manufacture. Check placement of reinforcing. Check the finish. Check the curing. Make test cylinders.

6. Specification Requirements: See *Standard Specifications* Sections 9-18. Review contract documents to determine if supplemental specifications apply.

9-4.54 Prestressed Concrete Products

1. Approval of Source: Approval of manufacturer is required.

2. Preliminary Samples: Not required.

3. Acceptance: Acceptance will be based on "APPROVED FOR SHIPMENT" tags from plant inspection and on field inspection for damage due to shipping and handling.

4. Assurance: Assurance samples are not required from the Project Engineer. Sampling is performed during fabrication by the plant Inspector under the Regional Materials Engineer.

5. Field Inspection: Check for damage due to shipping and handling.

6. Specification Requirements: See *Standard Specifications* Section 6-02.3(25) and Section 9-19. Review contract documents to determine if supplemental specifications apply.

9-4.55 Raised Pavement Markers, Types 1, 2, and 3

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Type 1 markers shall be from tested and approved lots identified with an "APPROVED FOR SHIPMENT" stamp or tag. After use, all emptied, marked boxes shall be destroyed. Type 1 thermoplastic markers shall be sampled and tested prior to incorporating into the project. A sample shall consist of three markers per job lot (from different boxes) for each color.

Type 2 markers accept on verification of "Stimsonite" or "Ray O Lite" brand.

Type 3 markers accept on approval of source. No acceptance samples required unless directed by source approval.

4. Assurance: Samples not required.

5. Field Inspection: A visual inspection shall be made to ensure that cracked or damaged lane markers are not incorporated in the work.

Washington State
Department of Transportation
Sid Morrison
Secretary of Transportation

Transportation Building
P.O. Box 47300
Olympia, WA 98504-7300

Dear

Following up on the initial, informal discussions, the Washington State Department of Transportation (WSDOT) is prepared to move toward the acceptance of guardrail based on contractor/subcontractor certification. The details of the operational system from the WSDOT viewpoint is set forth in the enclosed copy of memorandum.

From the standpoint of the contract operations, we see these as the key points:

1. Guardrail contractors/subcontractors will be identified on a prequalified materials list, based on their individual request.

2. For a specific contract, the Prime Contractor will identify the proposed use of an approved guardrail contractor/subcontractor by the submittal of a Request for Approval of Materials Source (RAMS) to the Project Engineer.

3. Guardrail materials utilized by the contractor/subcontractor will be certified by the original suppliers and these records will be maintained by the guardrail contractor/subcontractor, traceable to project utilization for a period of five (5) years after the completion of any affected contract. The certifications on file will meet the requirements of a manufacturers' Certificate of Compliance.

4. Following approval by the Project Engineer under the delegated authority, no further materials documentation will be required during the course of the work concerning steel guardrail and components and timber posts and blocks.

5. At the conclusion of the work, the guardrail contractor/subcontractor will furnish the Project Engineer a certification enumerating the items and quantities furnished for the guardrail installation and attesting as to the materials conformance to the WSDOT contract provision. This must also include documentation of steel materials as to their conformance to the "Buy American" Special Provision included in federal aid projects.

In order to proceed with this process, we have prepared an agreement letter for your consideration and execution if you wish to be established as an Approved Guardrail contractor/subcontractor for materials documentation purposes. Please complete this form and include a RAMS for the materials sources which you contemplate utilizing.

If you have further questions, please contact the Olympia Service Center Materials Laboratory.

Sincerely

Figure 9-4

Guardrail Contractor/Subcontractor Approval Request

WSDOT
Materials Engineer
P.O. Box 167
Olympia, WA 98507-0167

Dear Sir:

We request approval as a Qualified Guardrail Contractor/Subcontractor for the purpose of Materials Acceptance Documentation. Guardrail materials will be furnished from only those sources indicated on the enclosed Request for Approval of Materials Sources or as amended during the calendar year. Materials furnished and installed on WSDOT Construction Contracts will be fully documented pior to final acceptance of the work as to quantities of components provided. All materials furnished will be documented in the subcontractor's files by means of Manufacturer's Certificates of Compliance as to their conformance to the contract specifications. Such records will be maintained for a period of five (5) years after installation.

_____
(Company)

_____
(Signature)

_____
(Address)

Figure 9-5

6. Specification Requirements: See *Standard Specifications* Section 9-21. Review contract documents to determine if supplemental specifications apply.

9-4.56 Signing Materials

1. Approval of Source: Approval of Sign Fabricator is required.

> **Note**: Sources for the signing materials are approved on an annual basis for each sign fabricator. The sign fabrication inspector will arrange for the annual source approval and for new sources of signing materials as necessary.

2. Preliminary Samples: A preliminary sample for pre-qualification of a source will be required only if requested on the Request for Approval of Material Sources Form 350-071.

3. Acceptance: The finished sign will be accepted based on a "FABRICATION APPROVED" decal attached to the back of each sign. A Sign Acceptance Report (SAR) will be issued by the sign fabrication inspector which will confirm that all materials incorporated in the signs are accepted.

> **Note**: Reflective sheeting, legend, and prismatic reflectors shall be tested and accepted based on a "lot" of material. A "lot" is defined as the amount of sheeting or legend received by a fabricator in a single shipment. All rolls or individual shipping units within a lot shall be sampled and tested.

4. Assurance: Samples not required.

5. Field Inspection: Check "Fabrication Approved" decal. Check for damage due to shipping, handling, and installation.

6. Specification Requirements: See *Standard Specifications* Sections 9-18. Review contract documents to determine if supplemental specifications apply.

9-4.57 Concrete Curing Compounds

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample of 1 liter (1 quart) for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Submit 1 liter (1 quart) for each lot of curing compound delivered to each project. Material will be accepted based on satisfactory test results from the Olympia Service Center Materials Laboratory on samples taken from the project. No curing compound shall be used on WSDOT work prior to testing of each lot. Samples must be submitted for testing 10 days prior to use of curing compound.

4. Assurance: Samples are not required.

5. Field Inspection: Check different lots for similarity in appearance and working properties.

6. Specification Requirements: Are covered in general in the *Standard Specifications* Section 9-23, but additional requirements may be specified in giving approval. Review contract documents to determine if supplemental specifications apply.

9-4.58 Air Entraining Admixtures and Water Reducing Admixtures

1. Approval of Source: Approval of source is required before use.

2. Preliminary Samples: A preliminary sample of 1 liter (1 quart) for pre-qualifying will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance will be on the basis of Manufacturer's Certificate of Compliance.

4. Assurance: Samples are not required.

5. Field Inspection: Check for thorough mixing of containers before use. Check dispensing equipment for correct discharge.

6. Specification Requirements: See *Standard Specifications* Section 9-23.6. Review contract documents to determine if supplemental specifications apply.

9-4.59 Plastic Waterstop

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on basis of Manufacturer's Certificate of Compliance.

4. Assurance: Samples not required.

5. Field Inspection: Check for uniformity of product in lot, and for damage in shipment or handling.

6. Specification Requirements: See *Standard Specifications* Section 9-24. Review contract documents to determine if supplemental specifications apply.

9-4.60 Epoxy Resins

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample of 1 liter (1 quart) for pre-qualifying a source will be required only

if equested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of satisfactory test report from the Olympia Service Center Materials Laboratory. Submit mix ratios, intended use, and sufficient component materials to produce 1 liter (1 quart) of the mixture for each batch or lot number. Lane Marker adhesive does not require field sampling.

4. Assurance: Samples are not required.

5. Field Inspection: Check for uniformity of color and conformance to required mix proportions. Streaking is an indication of inadequate mixing. Check for set and hardness with your thumbnail. You should not be able to dent the properly mixed and cured material.

Synthetic binders shall be mixed and applied in conformance to manufacturer's written instructions unless otherwise modified in writing by the manufacturer's agent.

6. Specification Requirements: See *Standard Specifications* Section 9-26. Review contract documents to determine if supplemental specifications apply.

9-4.61 Gabion Baskets

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071. The sample shall be as shown in 3a to 3d below.

3. Acceptance: Acceptance is based on receipt of a Manufacturer's Certificate of Compliance with accompanying Mill Test Report. Acceptance sample may be requested by the Project Engineer or the Olympia Service Center Materials Laboratory and shall consist of the following:

   a. One square meter (yard) of mesh including selvage and body wire.

   b. One meter (3 feet) of tie wire.

   c. One meter (3 feet) of lacing wire.

   d. Six each, wire clips, fasteners.

4. Assurance: Samples not required.

5. Field Inspection: Check for damage.

6. Specification Requirements: See *Standard Specifications* Section 9-27.3. Review control documents to determine if supplemental specifications apply.

9-4.62 Sign Structures

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: The fabricated sign structure will be accepted on the basis of an "APPROVED FOR SHIPMENT" stamp or tag. When the structures are fabricated out-of-state and are shipped directly to the job site, arrangements must be made with the Materials Fabrication Inspection Office to have the structures inspected prior to erection.

4. Assurance: Samples are not required.

5. Field Inspection: Check for "APPROVED FOR SHIPMENT" tags or stamps and damage due to shipping, handling and erection.

6. Specification Requirements: See design standards and *Standard Specifications* Section 9-28.15. Review contract documents to determine if supplemental specifications apply.

9-4.63 Conduit

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance:

   a. Galvanized conduit shall be accepted on receipt of satisfactory test reports. Each sample requires two 300-mm (12-inch) sections, one from each end of a standard length of conduit. Resampling, when directed, requires twice the number of pieces specified. Be sure that matching end pieces are identified.

   b. Fiber reinforced plastic, flexible, and plastic conduit shall be accepted on Manufacturer's Certificate of Compliance or on catalog cuts.

4. Assurance: Samples not required.

5. Field Inspection: Check for Underwriters approval labels. Check for damage to coatings in shipping and handling, and see that damaged areas and field cut threads are protected with an approved coating.

6. Specification Requirements: See *Standard Specifications* Section 9-29.1. Review contract documents to determine if supplemental specifications apply.

9-4.64 Electrical Conductors

1. Approval of Source: Approval of Source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Conductors are accepted on receipt of satisfactory test results from the Olympia Service Center Materials Laboratory.

a. Single Conductors: (electrical conductor for power feed or distribution, loop detector, or building and control wiring are typical applications). A sample is required for each manufacturer, insulation type, and wire size as described below from at least one unit (roll, carton, or reel) of each group of five units or less. An additional sample shall be taken from each five units or fraction thereof. Ensure that sample taken contains the complete printed/stamped designation: manufacturer, size, insulation type.

i. For conductors, size #2 and larger, a 600-mm (2-foot) sample is required.

ii. For conductors, size #4 and smaller, a 5-meter (15-foot) sample for each manufacturer type and size of conductor. The 5-meter (15-foot) sample will suffice for the required sample for up to the first five units of that size, type, and manufacturer. For additional conductor of the same size, type, and manufacturer, a 600-mm (2-foot) sample from each five units or fraction thereof is required.

b. Multiple Conductors: (traffic signal wiring, pole and bracket cable, opticom control, loop detector lead-in, or coaxial cables) A sample is required for each manufacturer, type, size, and brand. One 600-mm (2-foot) sample as described above for each five units or fraction thereof.

c. Fiber Optic Systems. No sampling of Fiber Optic cables or systems is required.

4. Assurance Samples: No Assurance Samples are required.

5. Field Inspection: A visual inspection shall be made to ensure that no conductors with damaged insulation are incorporated into the project.

6. Specification Requirements: See *Standard Specifications* Section 9-29.3. Review Contract Documents to determine if supplemental requirements apply.

9-4.65 Signal, Luminaire, and Strain Poles

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: If poles were inspected prior to shipment to job site, they will be stamped or tagged “APPROVED FOR SHIPMENT.” If not, poles must be inspected on job site by the Olympia Service Center Materials Inspection staff prior to installation. Acceptance will be based on approved shop drawings per Chapter 8-20.2B of this manual, Mill Test Certificates supplied by the manufacturer, and Material Acceptance Reports.

4. Assurance: Samples not required.

5. Field Inspection: Check for shipping and handling damage. Arrange for inspection if not tagged.

6. Specification Requirements: See *Standard Specifications* Section 9-29.6. Review contract documents to determine if supplemental specifications apply.

9-4.66 Luminaires and Lamps

1. Approval of Material: Approval of material is required, either by being listed on the QPL or approved by RAM.

2. Preliminary Samples: Not required if the product is listed on the QPL. For products not listed on QPL, submit one luminaire with catalog cut and manufacturers photometric data to the Olympia Service Center Materials Laboratory for evaluation.

3. Acceptance: Luminaires may be field accecpted based on a catalog cut and inclusion on the QPL or approved by the Olympia Service Center Materials Laboratory from materials submitted for evaluation with a RAM.

4. Assurance: Samples not required.

5. Field Inspection: A visual inspection shall be made to ensure damaged equipment is not installed and that luminaires are mounted level. Confirm the socket position is the same as that noted on the catalog cut.

6. Specification Requirements: See *Standard Specifications* Section 9-29.10. Review contract documents to determine if supplemental specifications apply.

9-4.67 Water Distribution System

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted in lieu of sampling upon receipt of an “APPROVED” document as shown below:

a. Ductile Iron Pipe — Manufacturer’s Certificate of Compliance.

b. Concrete Cylinder Pipe — Shop Drawings and “APPROVED FOR SHIPMENT” stamp or tag.

c. Steel Pipe (less than 150 mm (6 inches)) — Manufacturer’s Certificate of Compliance.

d. Steel Pipe (150 mm (6 inches) and larger) — Manufacturer’s Certificate of Compliance.

e. Transition Reducing and Flexible Couplings — Catalog Cut.

f. Restrained Joint Coupling — Catalog Cut.

g. Gate Valves (400 mm (16 inches) and larger) — Catalog Cut.

h. Butterfly Valves — Manufacturer's Certificate of Compliance.

i. Valve Boxes — Catalog Cut.

j. Combination Air Release/Air Vacuum Valves — Catalog Cut.

k. Hydrants — Catalog Cut.

l. Service Connection — Saddles — Catalog Cut.

m. Service Connection — Corporation Stops — Catalog Cut.

n. Service Connection — Service Pipe (Copper) — Catalog Cut.

o. Service Connection — Service Pipe (Polyethylene) — Catalog Cut.

p. Service Connection — Service Pipe (Polybutalene) — Catalog Cut.

q. Service Connection — Compression Couplings — Catalog Cut.

r. Service Connection — Insulating Couplings — Catalog Cut.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check material delivered to the project for damage, and conformance to the contract documents.

6. Specification Requirements: See *Standard Specifications* Section 9-30. Review contract documents to determine if supplemental specifications apply.

9-4.68 Elastomeric Bearing Pads

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: Material may be accepted on a Manufacturer's Certificate of Compliance accompanied by a certified test report identifying the specific batch of material and conforming to AASHTO M251.

4. Assurance: Samples not required.

5. Field Inspection: Make certain that material to be used is from the certified batch.

6. Specification Requirements: See *Standard Specifications* Section 9-31. Review contract documents to determine if supplemental specifications apply.

9-4.69 Fabric Pad Bearings

1. Approval of Source: Approval of source is required for the fabricator and all material components of the bearings.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Material may be accepted on receipt of the following "APPROVED" documentation and "SATISFACTORY" Test Reports for the various material items used in the Fabric Pad Bearing Manufacturer:

a. Polytetrafluorethylene (TFE) sheeting, fabric, and elastomer — Manufacturer's Certificate of Compliance.

b. Steel Plates and shapes including stainless steel — Manufacturer's Certificate of Compliance.

c. TFE and stainless steel coefficient of friction requirements — Certified Test Reports from independent testing laboratory.

d. Proof load testing reports for preformed fabric pads — Certified Test Reports from independent testing laboratory.

e. Sample of preformed fabric pad — "SATISFACTORY" Test Report from the Olympia Service Center Materials Laboratory.

f. Field Inspection of bearing assemblies — Contact the Seattle Inspection Office for field inspection and receipt of field inspection results.

4. Assurance: None required.

5. Field Inspection: A representative of the Material Fabrication Inspection Office will inspect the bearings for defects in workmanship and issue a report prior to the installation of any bearing assemblies.

6. Specification Requirements: Review the contract documents to determine the specification requirements.

9-4.70 Precast Concrete Barrier

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: If items were inspected prior to shipment to job site, they will be stamped or tagged "APPROVED FOR SHIPMENT."

4. Assurance: Samples not required.

5. Field Inspection: Check for shipping and handling damage and "APPROVED FOR SHIPMENT" stamp or tag.

6. Specification Requirements: See *Standard Specifications* Section 6-10. Review contract documents to determine if supplemental specifications apply.

9-4.71 Safety Bars, Cattle Guards, Sign Mounting Brackets, Steel and Special Guardrail Posts, Steel Sign Posts

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required only if requested on Request for Approval of Material Sources Form 350-071.

3. Acceptance: Materials may be accepted on receipt of Manufacturer's Certificate of Compliance.

4. Assurance: Samples are not required from the job.

5. Field Inspection: Check each lot of material delivered to the project for damage, and that accompanying Manufacturer's Certificate of Compliance is present.

6. Specification Requirements: See *Standard Specifications* Section 9-05.18, 9-16.3(2), 9-28.15(1) and Standard Plans. Review contract documents to determine if supplemental specifications apply.

7. Field Inspection: Identify lots with test reports. Check for handling or shipping damage.

9-4.72 Metal Bridge Rail

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: Not required.

3. Acceptance: If rails were inspected prior to shipment to job site, they will be stamped or tagged "APPROVED FOR SHIPMENT." If not, rails must be inspected on job site by the Olympia Service Center Materials Inspection staff prior to installation. Acceptance will be based on approved shop drawings per Chapter 8-20.2B of this manual, Mill Test Certificates supplied by the manufacturer, and Material Acceptance Reports.

4. Assurance: Samples will not be required.

5. Field Inspection: Check for "APPROVED FOR SHIPMENT" tags or stamp. Check for damage caused by shipping and handling. Unless aluminum parts have been adequately wrapped, there may be damage to anodic and lacquer coating. Damaged parts shall be rejected.

6. Specification Requirements: See *Standard Specifications* Section 6-06.3(2). Review contract documents to determine if supplemental specifications apply.

9-4.73 Construction Geotextiles

1. Approval of Source: Approval of source is required.

2. Preliminary Samples: A preliminary sample for pre-qualifying a source will be required if requested on the Request for Approval of Material Sources Form 350-071.

3. Acceptance: Acceptance will be on Manufacturer's Certification of Compliance for quantities within the limits stated in the contract provisions. Satisfactory test reports from the Olympia Service Center Materials Laboratory for quantities which exceed the limits of the contract provisions. Sample per WSDOT Test Method 914.

4. Assurance: Assurance samples not required.

5. Field Inspection: Check each roll of geotextile fabric for proper identification as shown on either the Manufacturer's Certification of Compliance or on the Olympia Service Center Materials Laboratory test report.

6. Specification Requirements: Review contract provisions for current specifications.

9-5 Guidelines for Job Site Control of Materials

9-5.1 General

When in doubt as to sampling requirements, refer to Record of Materials, Form 350-029; Request for Approval of Material Sources Form 350-071; and Chapter 9-4 of this manual.

In some instances, to avoid delays and unnecessary expense to the Contractor, certain items usually sampled by project personnel may be sampled and tested by the Olympia Service Center Materials Laboratory at the warehouse or at the point of shipment. Such items, when properly identified with an "Approved for Shipment" tag, may be accepted for use by the Project Engineer without any further sampling or testing; however, a visual check for damages due to shipment and handling should be made before incorporating the materials into the work. Arrangements for such warehouse or point-of-shipment inspection and testing should be made with the Laboratory by project personnel to ensure common basis for acceptance and preclude unnecessary duplication of sampling and testing.

9-5.2 Sampling and Testing Schedule

9-5.2A General

The intent of sampling and testing is to ensure that the material provided to the project conforms to the specifications. The frequency schedule in Chapter 9-5.7 covers the minimum requirements for sampling and testing at the project level. The Project Engineer is responsible for obtaining the number of samples necessary to effect adequate control of the material being produced under the circumstances and conditions involved with the particular project. In some instances, good construction practice will necessitate more frequent tests to ensure adequate control of the quality of production. This will be the case where production is just getting under way, where source material is heterogeneous, or where production is variable or marginal in quality. Also operations from commercial sources when small lots of material are being sampled (as for barge loads of aggregate) or when stockpiles are built and depleted may require more frequent sampling and testing.

The instructions listed in Chapter 9-5.7 will be followed in the production of those surfacing materials covered therein. A minimum of one acceptance and one assurance test is required except for small quantities as shown in Paragraph 9-5.2C.

9-5.2B Reducing Frequency of Testing

In instances of uniform production where the material is running well within specification limits, deviations from the schedule may be effected by the Project Engineer. Deviations exceeding a 10 percent reduction will require approval from the Olympia Service Center Materials Laboratory and must be properly documented in the project records, and fully explained by the Project Engineer. Lack of personnel, equipment, and facilities will not be considered sufficient reasons for such deviation. When a reduction in the number of acceptance and assurance samples is approved, it shall also apply to a proportional reduction in the number of independent assurance samples.

Authority for approval of frequency reduction may be delegated to the Regional Materials Engineer upon request. This authority may permit overall reduction of sampling frequency or selective relief of selected test properties. Examples of selective relief would be reduction/elimination of fracture determinations for production from quarry sources or reduction of frequency for sand equivalent determination. As a general principle, frequency reduction may be considered whenever five consecutive samples taken at the normal frequency indicate full conformance with the specifications. For other reduction application, the Olympia Service Center Materials Laboratory may be consulted.

9-5.2C Sampling and Testing for Small Quantities of Material

Small quantities of material, except structurally critical concrete and pavement mixes placed on mainlines, ramps, and their shoulders, may be accepted from approved sources on the basis of one of the two following methods:

1. Acceptance on the basis of visual examination provided the source has been approved and has recently furnished similar material found to be satisfactory under WSDOT's normal sampling and testing procedures.

2. Acceptance on the basis of certification by the producer or supplier stating that the material complies with the specification requirements.

Acceptance of minor quantity materials by these methods must be fully documented and one copy of such documentation forwarded to the Olympia Service Center Materials Laboratory.

The primary documentation of acceptance of material under either of these two methods should be provided by the Project Engineer or Inspector accepting the material. The documentation may consist of a daily inspector's report with a statement as to the basis of acceptance of the material and the approximate quantity of material covered by the acceptance.

Amended acceptance procedures may be used when the total project quantities are less than one-half the minimum required sample frequency. This definition of minor quantities as well as considerations for other items without prescribed frequencies are accounted for in the preparation of the Record of Materials for the project. The minor quantities established at the time of preparing the Record of Materials are identified by <*> preceding the required acceptance criteria.

The principle involved, is to reduce the degree of inspection and testing by one degree whenever minor quantities (as defined above) are involved. The normal and relieved standards are as shown in the following table:

Standard Acceptance	Minor Quantity Acceptance
Acceptance Sample	
Aggregates	Visual Inspection
All Other Items	Certificate of Compliance
Certificate of Compliance	Visual Inspection
Approved Shipment Tags (MAR)	No Change
Pipe Acceptance Report	Visual Inspection
Proprietary Items (QPL in Specs)	No Change
Mill Test Reports	Visual Inspections
Catalog Cuts	No Change
Visual Inspection	
Landscape Materials	No Change

In applying this factor to the contract items, quantities representing a threshold cost value based on average bid prices are used. The same procedure may be used by the Project Engineer for components of bid items or for breakdown of lump sum items. For these items, and considering items which do not have critical structural importance, the Project Engineer may accept on the basis of visual inspection, materials having an estimated value of $200 or less. Fasteners (bolts and anchors) should be considered for structural importance especially. Whenever the inspector has reason to question the acceptability of material following visual inspection, normal sampling and testing should proceed before the material is accepted.

Quite often materials are supplied to projects from lots which have been tested and meet our specifications. Whenever this is the case, the producer or supplier could furnish a certificate stating the test results and that the material meets the requirements of the specifications; or he may refer to the project on which the lot was tested. In these cases, it would only be necessary for the Inspector to check the materials for storage or shipping damage. In case of doubt, confirmation of past approval can be secured by contacting the Olympia Service Center Materials Laboratory.

This acceptance procedure may be used for nonstructural miscellaneous areas of construction such as follows:

1. Auxiliary construction outside the shoulder line of the main roadways and ramps.

2. Safety improvement projects.

3. Rest areas.

4. Temporary construction work on larger projects (work that will be removed or abandoned before completion of the project).

Portland cement concrete from approved sources may be accepted for the following items on the basis of visual examination and occasional conventional field sampling and testing for characteristics such as slump and air, where specified, and occasional test beams or test cylinders, with only intermittent or random plant inspection as deemed necessary for control by the Project Engineer.

1. Finished, unfinished and temporary pavements not a part of a mainline, a ramp, or their shoulders; driveways; sidewalks; floors; slope paving: not exceeding 400 square meters (500 square yards) per day.

2. Curbs, gutters, ditch lining and similar items measured by linear measurement not exceeding 150 meters (500 linear feet) per day.

3. Miscellaneous usage such as building foundations, headers, anchors, metal pile shells, posts, catch basins, inlets, manhole bases, sign, signal and light bases, and similar work not to exceed 20 cubic meters (25 cubic yards) per day.

Under this system, arrangements should be made for the producer to state on the delivery ticket accompanying each load of concrete the class of concrete being furnished, the mass (weight) of cement, aggregates and water used in the batch and the time of batching. Only state-tested aggregates and supplier-certified cement, may be used.

Asphalt concrete from approved sources may be accepted for the following items on the basis of visual examination with only intermittent or random plant inspection as deemed necessary for control by the Project Engineer.

1. Pre-leveling course and patching including mainlines.

2. Driveways, sidewalks, road approaches, and parking areas.

3. Curbs and gutters.

4. Paved ditches and slopes.

Under this system, arrangements should be made for the producer to state on the delivery ticket accompanying each load of mix, the mass (weight) of the material and the percent of asphalt in the mix. Only state-tested aggregates and certified asphalt may be used. If payment for the item of the construction is by tonnes (tons), the amount of material accepted without providing a scaleperson on this basis shall be limited to 100 tonnes (tons) per day and 500 tonnes (tons) per project unless it is weighed by the Contractor's weighperson or on a commercial scale.

Asphalt concrete pavement placed on mainlines, intersections, ramps and their shoulders may be accepted without testing by the following procedure:

Total quantities of asphalt concrete, for quality assurance projects under Acceptance Plan C with quantities under 400 tonnes (tons) or other projects where job quantities are under 500 tonnes (tons) for placement as mainline, intersections, ramps, and shoulder paving may be accepted without acceptance testing on the day of production provided that all the following conditions have been met:

1. Materials Sources approved.

2. Aggregate tested and approved (Fracture and SE); Certified Asphalt Cement.

3. Previous production samples of the same class of mix from the proposed plant, produced within ten days prior to the paving operation have been tested by the Engineer and determined to be in full compliance with the specifications. Production for the small quantity shall be under the same plant operation and controls (bin masses (weights), plant rate, or feeder setting) as previously used.

Where the preceding conditions are not fulfilled, materials of minor quantities may be accepted on the basis of a single lot acceptance on an end product basis. Acceptability to be determined by a single representative sample. Test results shall be determined for at least two analyses of the same sample by different laboratory facilities. If the averaged results are not within the applicable tolerance bands, a price adjustment will apply to all material within the lot.

9-5.3 Point of Acceptance

STATE OWNED SOURCE: Material produced from State owned source may be accepted either as it is placed into stockpile or as it is placed in hauling vehicles for delivery to the roadway. The sampling and testing frequency during stockpiling shall be in conformance with Chapter 9-5.7 of this manual.

If the material is to be accepted as it is placed into stockpile, an occasional sample to confirm continued compliance with specification requirements shall be taken as the material is being removed from the stockpile for delivery to the roadway.

In the event sample testing during stockpiling shows the material to be marginal in any specification requirement, acceptance at this point shall be conditional and dependent on adherence to specifications at the time of removal from stockpile.

CONTRACTOR'S SOURCE: If stockpiled material is set aside exclusively for use on WSDOT projects it may be accepted the same as that for a state-owned source. If stockpiles are constructed for general use, then materials for WSDOT projects shall be sampled and tested for acceptance only when placed in vehicles for delivery to the roadway. If an existing stockpile was built without acceptance testing during material production, and later set aside exclusively for use on state projects, the material may be accepted in stockpile with appropriate test results from samples taken by the Engineer. The sampling and testing frequency shall conform to Chapter 9-5.7 of this manual.

9-5.4 Basis for Acceptance

The basis for acceptance of manufactured surfacing materials is compliance with existing specifications and is made by one of two methods:

1. Acceptance by Quality Assurance

For materials being accepted by quality assurance procedures, random samples will be statistically evaluated to determine quality level within a defined tolerance band. Acceptance, bonus, and disincentive procedures are defined in the Specifications.

The accuracy and reliability of testing is paramount under this process since significant monetary incentives may be affected. Accordingly, confirmation testing is required whenever widely varying test results are encountered.

Procedures for confirmation may be established by varying approaches dependent upon the material. These approaches will be defined by the department to ensure uniform application. They are intended to be applied by the field inspector or technician at the time the initial sample results are determined. They are to be applied only when the testing technician can not identify any errors or deviation occurring during the test procedure. Test results which are questioned due to acknowledged errors or equipment deficiencies are to be immediately discarded without recourse to the confirmation process.

Asphalt Concrete Pavement

Confirmation Test Procedure: Asphalt concrete test results shall be reviewed for aberrations in determination of asphalt content and of gradation passing the 6.30-mm (1/4-inch), 2.00-mm (#10), and 0.075-mm (#200) screens. Other test properties will not be subject to confirmation testing. A confirmation test shall consist of a retest of gradation on another portion of the original asphalt concrete sample and reevaluation of asphalt content by the same operator, test equipment, and procedures. Testing shall be conducted as soon as practical after completion of the initial test. Confirmation testing may be waived by the contractor's representative, if present, at the time for retest.

The retest for percent asphalt and all gradations 6.3-mm (1/4-inch), 2.00-mm (#10), and 0.075-mm (#200) will be performed under the following conditions:

Sublots	**Retest if:**
1 to 2 or until avg. and std. dev. are established	The test result falls outside the tolerance bands based on the applicable job mix formula.
3 or more	The test results fall outside the tolerance bands based on the applicable job mix formula and the test result is beyond 1½ standard deviations from the established average.

The original test results shall be considered as confirmed whenever the confirmation results fall within the limits of:

6.30 mm (1/4 inch)	±	4%
2.00 mm (#10)	±	2%
0.075 mm (#200)	±	0.4%
AC%	±	0.3%

Contractor's quality control results may be used to either confirm or establish the need for retest if they are available and based on a split of the sample or from independent sampling within one hour of the original sample. To be considered, the results must be based on the specified WSDOT test procedure.

When the results are confirmed, either by WSDOT testing or by comparison with the contractor's test results, the evaluation of the sublot shall be based on the original test results.

Whenever the results of the retest or comparison fall outside the above limits, the following procedure shall apply:

For Gradation:

A third set of test results shall be obtained from one of the following:

1. The contractor's quality control results. To be considered, they must be based on the specified WSDOT test procedures.

2. An additional set of WSDOT test results made on a portion of the material taken from the Nuclear Gage sample pan or other remnant of the original acceptance sample.

The three sets of test results so obtained shall be evaluated to determine which results from WSDOT testing are to be used to represent the sublot in question. The WSDOT test results taken initially are hereafter referred to as "**original**" test results. The WSDOT retest results, taken for confirmation are hereafter referred to as "**confirmation**" test results. The third set of test results whether taken by WSDOT or the contractor, are hereafter referred to as "**referee**" test results.

The following procedure will be utilized to determine the test of record for the sublot in question:

1. When contractor Q/C test results are used initially to confirm the original test results and it cannot be confirmed, the contractor's test results shall become the "referee" test. WSDOT will then run a retest from a portion of the original sample to establish the "confirmation" test results.

2. When WSDOT test results are used initially to confirm the original test results and it cannot be confirmed, Q/C test results may be used as the "referee" test.

3. The test results to be utilized as representing the sublot will be either the "original" or "confirmation" values as determined by the closest comparison to the "referee" test.

4. Contractor's Q/C test results will not be utilized to represent the test results of record for any sublot.

For Asphalt Content:

1. The source of asphalt shall be confirmed from the most recent Certificate of Asphalt Shipment. If the source does not match the calibration in use, the asphalt content determination is not valid and must be reevaluated using the specific calibration for the asphalt source.

2. If the source matches the calibration in use, the background reading shall be determined and reentered.

3. The mix design reference pan shall be rerun.

4. The test mass (weight) of the asphalt sample in question shall be verified against the calibration data and must be within 2 grams plus or minus.

5. The asphalt content shall be retested.

Unless the reference pan sample reading deviates by more then 0.2 percent from the reference reading obtained on arrival at the project, the asphalt content shall be entered as the average of the two determinations. When a deviation greater than 0.2 percent is noted a single-point calibration shall be run using aggregate sampled from the cold-feed and asphalt sampled on the project.

2. Acceptance by Non-Quality Assurance

Individual samples taken for acceptance determination may be subject to certain tolerances allowed outside the established value stated in the *Standard Specifications*. The tolerance acceptance procedures shall be followed in these cases.

The basis for acceptance of manufactured surfacing materials is compliance with existing specifications as modified to include the following tolerances. The application of these tolerances and the procedure to be used in material acceptance shall be conformity with the following guidelines:

The following shall be cause for immediate material rejection:

1. When a sample falls outside of the applicable tolerance bands.

2. When any two out of three consecutive samples are within tolerance bands, but outside specification limits.

3. When any sample has a gradation that falls within both the high and low tolerance bands as given for the stated point of acceptance.

4. Any sample where the material is outside the specification limits, but within the tolerance bands, in any two of the following properties:

Gradation (includes sand/silt ratio)
Fracture
Sand Equivalent

At any time a sample falls outside the specification limits, but within the tolerance bands, two additional samples representing current production shall immediately be taken in accordance with Chapter 5-4.2B of this manual. The Contractor may have the option of making plant adjustments prior to taking these samples. Production will be accepted until the second sample is checked in those properties shown to be out of specification in the first sample. If the second sample is also out of specification, acceptance of the material will halt immediately. If the second sample is within specification, the third sample will be checked immediately. If the third sample is out of specification, acceptance will cease. No further material will be accepted after the time of rejection until corrections are made in the operations and tests show the material to be within specification limits. Basis for acceptance after this correction will be in conformity with the procedure outlined above. All tests reflecting material outside the specification limits must be listed and justified on the Project Engineer's certification as required by Chapter 9-1.5 of this manual.

Material that has been produced prior to rejection (i.e., ACP in storage silo) may be incorporated into the project provided the Contractor is made fully aware that the material may be subject to a price adjustment or, in extreme cases, to total removal. Every effort shall be made to place this material in structurally noncritical areas such as shoulders or gore areas.

All material produced between the time of rejection and the time an acceptable material is produced, as defined by WSDOT tests, shall not be incorporated in the work in any manner until it meets specifications.

The tolerances shown hereinafter apply exclusively to the appropriate material specifications as listed in the *Standard Specifications*. These tolerances do not apply to those "special" materials having requirements differing from those listed in the *Standard Specifications*. For these "special" materials usually described in the special provisions, tolerances will be provided by the Olympia Service Center Materials Engineer upon request from the Regional Administrator.

All items for acceptance, except for sampling and testing PCC cores, testing concrete cylinder and cement and as shown in Chapter 9-5.5B will be sampled and tested by the Field Inspector.

9-5.5 Assurance Sampling and Testing

9-5.5A Independent Assurance Sampler

The Regional Administrator should assign a sufficient number of persons in each Region to handle the program for independent assurance sampling, testing and inspection review. These persons should be under the general direction of the Regional Materials Engineer.

It will be the duty of the Independent Assurance Sampler to conduct the independent assurance sampling program in accordance with the requirements of WSDOT.

It is essential that the Independent Assurance Sampler visit all projects, obtain the proper number of samples independently and observe the techniques of running the field test. A complete record should be kept of the sampling and testing performed during this inspection, the personnel whom contacted during the visit, and the suggestions or instructions that were left with the job personnel. Monthly reports of the Independent Assurance Sampler activities shall be submitted on Form 350-054.

The Assurance Samplers should be well trained and experienced in all phases of the work.

9-5.5B Assurance Sampling

The requirements for assurance sampling and testing are shown in Section 9-5.7. Note that if acceptance samples are taken more frequently than shown, the number of assurance samples will increase as one assurance sample and test is required for each five acceptance samples and tests for all aggregates.

Assurance sampling and testing will be done by the Field Inspector or the Independent Assurance Sampler as follows unless otherwise noted in Chapter 9-4 of this manual.

Three of every four assurance samples of aggregate may be taken by the field inspector and split two ways. One split will be tested by the inspector in the field as an acceptance sample and the other split will be submitted to the Regional Materials Laboratory as an assurance sample for immediate testing and comparison with field results. Assurance samples of asphalt mix will be split three ways and the final third sent directly to the Olympia Service Center Materials Laboratory.

The other one of four assurance samples of aggregate and asphalt mix will be taken by an independent sampler and will be split three ways. One split will be run in the field as an acceptance sample, the second split will be tested in the Regional Materials Laboratory and the third split will be sent to the Olympia Service Center Materials Laboratory for testing and comparison with the other two splits.

The results of the field and Regional Materials Laboratory tests should be submitted to the Olympia Service Center Materials Laboratory with their split of the sample.

It is the intent of this section that the independent assurance samples be taken totally random in manner. One of every four assurance samples on a project will be taken by the Independent Assurance Sampler. The Independent Assurance Sampler may be required to deviate from the "Every 4th" rule in order to accomplish this goal.

All assurance sampling and testing of portland cement concrete, including test beams, cylinder fabrication, slump, air and cement factor will be performed by the Independent Assurance Sampler. These assurance tests shall be done side by side with acceptance tests, and shall be performed with a separate set of testing equipment.

Compaction assurance testing of asphalt concrete will be witnessed and documented by the Independent Assurance Sampler at the frequency shown in Chapter 9-5.7 of this manual.

Assurance sample testing does not reflect on the acceptability of the material involved. Acceptance under the contract is determined by the acceptance testing process. Assurance testing is performed to obtain an independent verification of proper testing procedure and equipment. To achieve this goal, assurance samples and tests should employ another operator and separate set of testing equipment than that used for the acceptance tests. The operator may be the Assurance Inspector in person, the Regional Laboratory Foreman, or another qualified technician operating under their direction. The witnessing of procedures and tests as performed by the Acceptance Inspector does not constitute a valid assurance confirmation with the exception of nuclear density gauge testing that is specifically designed for witness testing.

When acceptance testing is done at the Regional Materials Laboratory, assurance samples will be required in the same manner as for acceptance sampling performed in the field. The assurance samples shall be tested by an individual other than the one performing the acceptance sample testing. Separate equipment should be used if available. It is recommended in this case that either the Region Laboratory Foreman or the Assurance Sampler perform the testing on the assurance samples. Transmittal of Independent Assurance Samples for testing in the Olympia Service Center Materials Laboratory shall follow the usual procedure.

9-5.5C Comparison of Assurance and Acceptance Test Results

Assurance sample results will be compared with the acceptance test results of the companion samples. Independent Assurance results will be compared with both the Assurance and Acceptance results.

Reports of the comparison of results will be provided to the Project Engineer and the Region Independent Assurance Sampler. Comments reflecting the degree of conformance will be entered in the remarks section of the report by the individual responsible for the test, either the Region Materials Engineer or Olympia Service Center Materials Engineer. The degree of conformance will be determined according to the deviation ranges noted below. Gradation test results will be compared only on specification screens.

Test	Normal Range of Deviation	Maximum Range of Deviation
Sand Equivalent	±8 points	±15 points
Fracture	±5 percent	±10 percent
Asphalt Content (ACP & ATB)	±0.3 percent	±0.6 percent
Air Content of Concrete	±1 percent	±2 percent
Slump of Concrete:		
19.0 mm (3/4 inch) Max. Aggregate and Specified Slump 75 mm (3 inches) or less	±0.5	±1
Specified Slump greater than 75 mm (3 inches) and 37.5 mm (1 1/2 inch) Max. Aggregate	±1	±1.5
Sieve Analysis — All Items:		
4.75 mm (No. 4) sieve and larger	±5 percent	±8 percent
3.35 mm (No. 6) sieve to 0.180 mm (No. 80) sieve	±3 percent	±6 percent
0.150 mm (No. 100) and 0.075 mm (No. 200) sieve	±2 percent	±4 percent

In the table above, "Normal Range" indicates an acceptable range of variation between test results and no action is required. Test results which fall in this category will be so indicated by the wording "*normal deviation*" on the assurance and independent assurance test reports.

Test results falling outside of the "Normal Range" but within the "Maximum Range," will be indicated by the wording "*questionable deviation*" on the assurance and independent assurance test reports. For deviations falling into this category, the Project Engineer or a representative shall review the original test report form, advise the responsible test operator of the deviation, and review the test procedure at the next opportunity.

Test results exceeding the maximum range will be indicated by the wording "*excessive deviation.*" For deviations falling in the excessive category, the Project Engineer or a representative will notify the Independent Assurance Sampler and/or Region Trainer for their services in corrective action. Corrective action will include review of sampling procedures, sample splitting procedures, testing procedures, and testing equipment.

Actions and results of these investigations will be documented by the Project Engineer by a notation or attachment to the assurance sample test report and by the Independent Assurance Inspector in the monthly periodic activity report. These may include comments or findings by the Region Trainer. Extracts or references to these results shall be included in the Project Engineer's Project Certification.

Independent assurance comparisons are by their nature delayed in reaching the Project Engineer. The comparisons may reflect a more severe degree of nonconformance than was noted in the assurance sample comparison. The Project Engineer's actions should be as appropriate to the situation. If the operator and test equipment are still available the follow-up action should be complete. If not, that information should be noted and provided to the Independent Assurance Inspector and to the Olympia Service Center Materials Laboratory Contract Documentation Section.

9-5.6 Tolerance Limits — Metric

Crushed Surfacing Top Course

	Specification Limits	Tolerance Limits
% Passing 19.0 mm	100	95-100
% Passing 6.30 mm	55-75	50-80
% Passing 0.425 mm	8-24	5-27
% Passing 0.075 mm	10.0 Max.	11.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Crushed Surfacing Base Course

	Specification Limits	Tolerance Limits
% Passing 31.5 mm	100	95-100
% Passing 16.0 mm	50-80	45-85
% Passing 6.30 mm	30-50	25-55
% Passing 0.475 mm	3-18	3-20
% Passing 0.075 mm	7.5 Max.	9.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Ballast

	Specification Limits	Tolerance Limits
% Passing 63 mm	100	100
% Passing 50 mm	65-100	60-100
% Passing 25.0 mm	50-85	45-90
% Passing 6.30 mm	30-50	25-60
% Passing 0.425 mm	16 Max.	20 Max.
% Passing 0.075 mm	9.0 Max.	10.0 Max.
Sand Equivalent	30 Min.	30 Min.
Dust Ratio	⅔ Max.	

Shoulder Ballast

	Specification Limits	Tolerance Limits
% Passing 63 mm	100	100
% Passing 19.0 mm	40-80	35-85
% Passing 6.30 mm	5 Max.	6 Max.
% Passing 0.150 mm (wet sieving)	0-2.0	0-2.9
Fracture	75% Min.	70% Min.

Maintenance Rock

	Specification Limits	Tolerance Limits
% Passing 12.5 mm	100	95 Min.
% Passing 6.30 mm	55-70	50-75
% Passing 0.425 mm	10-25	8-30
% Passing 0.075 mm	7.0 Max.	8.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Gravel Base

	Specification Limits	Tolerance Limits
% Passing 6.30 mm	25 Min.	20 Min.
% Passing 0.075 mm	10.0 Max.	11.0 Max.
Dust Ratio	⅔ Max.	
Sand Equivalent	30 Min.	25 Min.

Sand Drainage Blanket

	Specification Limits	Tolerance Limits
% Passing 63 mm	90-100	85-100
% Passing 6.30 mm	30-100	25-100
The portion passing 6.30 mm shall meet the following requirements for grading:		
% Passing 2.00 mm	50-100	45-100
% Passing 0.30 mm	0-30	0-35
% Passing 0.150 mm	0-7	0-8
% Passing 0.075 mm	0-3.0	0-3.9

Gravel Backfill for Walls

	Specification Limits	Tolerance Limits
% Passing 100 mm	100	100
% Passing 6.30 mm	25-70	20-75
% Passing 0.075 mm	5.0 Max.	6.0 Max.
Max. Dust Ratio	⅔ Max.	
Sand Equivalent	55 Min.	50 Min.

Gravel Backfill for Pipe Bedding

	Specification Limits	Tolerance Limits
% Passing 25.0 mm	100	100
% Passing 6.30 mm	25-80	20-85
% Passing 0.075 mm	15.0 Max.	16.0 Max.
Sand Equivalent	30 Min.	30 Min.

Gravel Backfill for Drains

	Specification Limits	Tolerance Limits
% Passing 25.0 mm	100	95-100
% Passing 19.0 mm	80-100	75-100
% Passing 9.50 mm	10-40	8-45
% Passing 4.75 mm	0-4	0-5
% Passing 0.075 mm	0-2	0-2.5

Backfill for Sand Drains

	Specification Limits	Tolerance Limits
% Passing 12.5 mm	90-100	85-100
% Passing 6.30 mm	65-100	60-100
% Passing 2.00 mm	40-100	35-100
% Passing 0.30 mm	3-30	2-35
% Passing 0.150 mm	0-4	0-5
% Passing 0.075 mm	0-3.0	0-3.9

Gravel Borrow

	Specification Limits	Tolerance Limits
% Passing 31.5 mm	100*	95-100
% Passing 6.30 mm	25 Min.	20 Min.
% Passing 0.425 mm	40 Max.	43 Max.
% Passing 0.075 mm	7.0 Max.	9.0 Max
Sand Equivalent	45 Min.	40 Min.

*Maximum size may be increased by Engineer's approval.

Crushed Coverstone

	Specification Limits	Tolerance Limits
% Passing 19.0 mm	100	95-100
% Passing 16.0 mm	95-100	90-100
% Passing 6.30 mm	30-50	26-54
% Passing 0.075 mm	0-7.5	0-9.0
Fracture	75% Min.	70% Min.
Sand Equivalent	35 Min.	30 Min.

Crushed Screenings 16.0 mm — 6.30 mm or B.S.T.

	Specification Limits	Tolerance Limits
% Passing 19.0 mm	100	95-100
% Passing 16.0 mm	95-100	90-100
% Passing 6.30 mm	0-10	0-15
% Passing 2.00 mm	0-3	0-7
% Passing 0.075 mm	0-1.0	0-2.0
Fracture	75% Min.	70% min.

Crushed Screenings 12.5 mm — 6.30 mm or B.S.T.

	Specification Limits	Tolerance Limits
% Passing 16.0 mm	100	95-100
% Passing 12.5 mm	95-100	90-100
% Passing 6.30 mm	0-15	0-20
% Passing 2.00 mm	0-3	0-7
% Passing 0.075 mm	0-1.0	0-2.0
Fracture	75% Min.	70% Min

Crushed Screenings 6.30 mm — 0 mm for B.S.T.

	Specification Limits	Tolerance Limits
% Passing 9.50 mm	100	95-100
% Passing 6.30 mm	90-100	85-100
% Passing 2.00 mm	30-60	26-64
% Passing 0.075 mm	0-10.0	0-11.0
Fracture	75% Min.	70% Min.

Crushed Screenings 19.0 mm — 12.5 mm for B.S.T.

	Specification Limits	Tolerance Limits
% Passing 25.0 mm	100	95-100
% Passing 19.0 mm	95-100	90-100
% Passing 12.5 mm	0-20	0-25
% Passing 9.50 mm	0-5	0-10
% Passing 0.075 mm	0-1.0	0-2.0
Fracture	75% Min.	

Select Borrow

	Specification Limits	Tolerance Limits
% Passing 100 mm	100	95-100
% Passing 0.425 mm	50 Max.	55 Max.
% Passing 0.075 mm	10.0 Max.	12.0 Max.
Sand Equivalent	15 Min.	12 Min.

Crushed Screenings 16.0 mm — 2.00 mm

	Specification Limits	Tolerance Limits
% Passing 19.0 mm	100	95-100
% Passing 16.0 mm	95-100	90-100
% Passing 6.30 mm	30-50	26-54
% Passing 2.00 mm	0-10	0-12
% Passing 0.075 mm	0-1.0	0-2.0
Fracture	75% Min.	70% Min.

Crushed Screening 9. 50 mm — 2.00 mm

	Specification Limits	Tolerance Limits
% Passing 12.5 mm	100	95-100
% Passing 9.50 mm	90-100	85-100
% Passing 6.30 mm	50-75	45-80
% Passing 2.00 mm	0-10	0-12
% Passing 0.075 mm	0-1.0	0-2.0
Fracture	75% Min.	70% Min.

Aggregate in Asphalt Concrete Mix

Classes A & B	Specification Limits	Tolerance Limits
% Passing 19.0 mm≤	100	100
% Passing 12.5 mm≤	90-100	85-100
% Passing 9.50 mm≤	75-90	70-95
% Passing 6.30 mm≤	55-75	50-80
% Passing 2.00 mm	30-42	26-46
% Passing 0.425 mm	11-24	9-27
% Passing 0.075 mm	3.0-7.0	2.0-9.0
Class D		
% Passing 16.0 mm≤		100
% Passing 12.5 mm≤	100	97-100
% Passing 9.50 mm≤	97-100	94-100
% Passing 4.75 mm	30-50	26-54
% Passing 2.36 mm	5-15	3-17
% Passing 0.075 mm	2.0-5.0	0-7.0
Class E		
% Passing 37.5 mm≤		100
% Passing 31.5 mm≤	100	95-100
% Passing 25.0 mm≤	90-100	85-100
% Passing 16.0 mm≤	67-86	63-90
% Passing 12.5 mm≤	60-80	56-84
% Passing 6.30 mm≤	40-62	36-66
% Passing 2.00 mm	25-40	21-44
% Passing 0.425 mm	10-23	7-26
% Passing 0.075 mm	2.0-9.0	2.0-10.0
Class F		
% Passing 25.0 mm≤		100
% Passing 19.0 mm≤	100	95-100
% Passing 12.5 mm≤	80-100	75-100
% Passing 6.30 mm≤	45-78	40-83
% Passing 2.00 mm	30-50	26-54
% Passing 0.075 mm	2.0-8.0	2.0-10.0

Aggregate for Asphalt Concrete

Class G		
% Passing 16.0 mm≤		100
% Passing 12.5 mm≤	100	97-100
% Passing 9.50 mm≤	97-100	94-100
% Passing 6.30 mm≤	60-88	55-92
% Passing 2.00 mm	32-53	28-57
% Passing 0.425 mm	11-24	9-27
% Passing 0.075 mm	3.0-7.0	2.0-9.0
Fracture:		
Class A	90% Min.	85% Min.
Classes B & G	75% Min.	70% Min.
Class D		
1 Fractured Face	90% Min.	85% Min.
2 Fractured Faces	75% Min.	70% Min.
Classes E & F	50% Min.	45% Min.
Sand Equivalent:		
Classes A, B, D, E & G	40 Min.	35 Min.
Class F	35 Min.	30 Min.

Asphalt Treated Base

% Passing 50 mm≤	100	100
% Passing 12.5 mm≤	56-100	54-100
% Passing 6.30 mm≤	40-78	35-83
% Passing 2.00 mm	22-57	18-61
% Passing 0.425 mm	8-32	5-35
% Passing 0.075 mm	2.0-9.0	2.0-11.0
Sand Equivalent	35 Min.	

9-5.6 Tolerance Limits — English

Crushed Surfacing Top Course

	Specification Limits	Tolerance Limits
% Passing ⅝″	100	95-100
% Passing ¼″	55-75	50-80
% Passing No. 40	8-24	5-27
% Passing No. 200	10.0 Max.	11.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Crushed Surfacing Base Course

	Specification Limits	Tolerance Limits
% Passing 1¼″	100	95-100
% Passing ⅝″	50-80	45-85
% Passing ¼″	30-50	25-55
% Passing No. 40	3-18	3-20
% Passing No. 200	7.5 Max.	9.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Ballast

	Specification Limits	Tolerance Limits
% Passing 2½″	100	100
% Passing 2″	65-100	60-100
% Passing 1″	50-85	45-90
% Passing ¼″	30-50	25-60
% Passing No. 40	16 Max.	20 Max.
% Passing No. 200	9.0 Max.	10.0 Max.
Sand Equivalent	30 Min.	30 Min.
Dust Ratio	⅔ Max.	

Shoulder Ballast

	Specification Limits	Tolerance Limits
% Passing 2½″	100	100
% Passing ¾″	40-80	35-85
% Passing ¼″	5 Max.	6 Max.
% Passing No. 100 (wet sieving)	0-2.0	0-2.9
Fracture	75% Min.	70% Min.

Maintenance Rock

	Specification Limits	Tolerance Limits
% Passing ½″	100	95 Min.
% Passing ¼″	55-70	50-75
% Passing No. 40	10-25	8-30
% Passing No. 200	7.0 Max.	8.0 Max.
Sand Equivalent	35 Min.	30 Min.
Fracture	75% Min.	70% Min.

Gravel Base

	Specification Limits	Tolerance Limits
% Passing ¼″	25 Min.	20 Min.
% Passing No. 200	10.0 Max.	11.0 Max.
Dust Ratio	⅔ Max.	
Sand Equivalent	30 Min.	25 Min.

Sand Drainage Blanket

	Specification Limits	Tolerance Limits
% Passing 2½″	90-100	85-100
% Passing ¼″	30-100	25-100
The portion passing ¼″ shall meet the following requirements for grading:		
% Passing No. 10	50-100	45-100
% Passing No. 50	0-30	0-35
% Passing No. 100	0-7	0-8
% Passing No. 200	0-3.0	0-3.9

Gravel Backfill for Walls

	Specification Limits	Tolerance Limits
% Passing 4″	100	100
% Passing ¼″	25-70	20-75
% Passing No. 200	5.0 Max.	6.0 Max.
Max. Dust Ratio	⅔ Max.	
Sand Equivalent	55 Min.	50 Min.

Gravel Backfill for Pipe Bedding

	Specification Limits	Tolerance Limits
% Passing 1″	100	100
% Passing ¼″	25-80	20-85
% Passing No. 200	15.0 Max.	16.0 Max.
Sand Equivalent	30 Min.	30 Min.

Gravel Backfill for Drains

	Specification Limits	Tolerance Limits
% Passing 1″	100	95-100
% Passing ¾″	80-100	75-100
% Passing ⅜″	10-40	8-45
% Passing No. 4	0-4	0-5
% Passing No. 200	0-2	0-2.5

Backfill for Sand Drains

	Specification Limits	Tolerance Limits
% Passing ½″	90-100	85-100
% Passing ¼″	65-100	60-100
% Passing No. 10	40-100	35-100
% Passing No. 50	3-30	2-35
% Passing No. 100	0-4	0-5
% Passing No. 200	0-3.0	0-3.9

Gravel Borrow

	Specification Limits	Tolerance Limits
% Passing 1¼″	100*	95-100
% Passing ¼″	25 Min.	20 Min.
% Passing No. 40	40 Max.	43 Max.
% Passing No. 200	7.0 Max.	9.0 Max
Sand Equivalent	45 Min.	40 Min.

*Maximum size may be increased by Engineer's approval.

Select Borrow

	Specification Limits	Tolerance Limits
% Passing 6″	100	95-100
% Passing No. 40	50 Max.	55 Max.
% Passing No. 200	10.0 Max.	12.0 Max
Sand Equivalent	15 Min.	12 Min.

Crushed Coverstone

	Specification Limits	Tolerance Limits
% Passing ¾″	100	95-100
% Passing ⅝″	95-100	90-100
% Passing ¼″	30-50	26-54
% Passing No. 200	0-7.5	0-9.0
Fracture	75% Min.	70% Min.
Sand Equivalent	35 Min.	30 Min.

Crushed Screenings ⅝″ — ¼″ or B.S.T.

	Specification Limits	Tolerance Limits
% Passing ¾″	100	95-100
% Passing ⅝″	95-100	90-100
% Passing ¼″	0-10	0-15
% Passing No. 10	0-3	0-7
% Passing No. 200	0-1.0	0-2.0
Fracture	75% Min.	70% min.

Crushed Screenings ½″ — ¼″ or B.S.T.

	Specification Limits	Tolerance Limits
% Passing ⅝″	100	95-100
% Passing ½″	95-100	90-100
% Passing ¼″	0-15	0-20
% Passing No. 10	0-3	0-7
% Passing No. 200	0-1.0	0-2.0
Fracture	75% Min.	70% Min

Crushed Screenings ¼″— 0″ for B.S.T.

	Specification Limits	Tolerance Limits
% Passing ⅜″	100	95-100
% Passing ¼″	90-100	85-100
% Passing No. 10	30-60	26-64
% Passing No. 200	0-10.0	0-11.0
Fracture	75% Min.	70% Min.

Crushed Screenings ¾″ — ½″ for B.S.T.

	Specification Limits	Tolerance Limits
% Passing 1″	100	95-100
% Passing ¾″	95-100	90-100
% Passing ½″	0-20	0-25
% Passing ⅜″	0-5	0-10
% Passing No. 200	0-1.0	0-2.0
Fracture	75% Min.	

Crushed Screenings ⅝″ — #10

	Specification Limits	Tolerance Limits
% Passing ¾″	100	95-100
% Passing ⅝″	95-100	90-100
% Passing ¼″	30-50	26-54
% Passing No. 10	0-10	0-12
% Passing No. 200	0-1.0	0-2.0
Fracture	75% Min.	70% Min.

Crushed Screening ⅜″ — #10

	Specification Limits	Tolerance Limits
% Passing ½″	100	95-100
% Passing ⅜″	90-100	85-100
% Passing ¼″	50-75	45-80
% Passing No. 10	0-10	0-12
% Passing No. 200	0-1.0	0-2.0
Fracture	75% Min.	70% Min.

Aggregate in Asphalt Concrete Mix

	Specification Limits	Tolerance Limits
Classes A & B		
% Passing ¾″	100	100
% Passing ½″	90-100	85-100
% Passing ⅜″	75-90	70-95
% Passing ¼″	55-75	50-80
% Passing No. 10	30-42	26-46
% Passing No. 40	11-24	9-27
% Passing No. 200	3.0-7.0	2.0-9.0
Class D		
% Passing ⅝″		100
% Passing ½″	100	97-100
% Passing ⅜″	97-100	94-100
% Passing No. 4	30-50	26-54
% Passing No. 8	5-15	3-17
% Passing No. 200	2.0-5.0	0-7.0
Class E		
% Passing 1½″		100
% Passing 1¼″	100	95-100
% Passing 1″	90-100	85-100
% Passing ⅝″	67-86	63-90
% Passing ½″	60-80	56-84
% Passing ¼″	40-62	36-66
% Passing No. 10	25-40	21-44
% Passing No. 40	10-23	7-26
% Passing No. 200	2.0-9.0	2.0-10.0
Class F		
% Passing 1″		100
% Passing ¾″	100	95-100
% Passing ½″	80-100	75-100
% Passing ¼″	45-78	40-83
% Passing No. 10	30-50	26-54
% Passing No. 200	2.0-8.0	2.0-10.0

Aggregate for Asphalt Concrete

Class G		
% Passing ⅝″		100
% Passing ½″	100	97-100
% Passing ⅜″	97-100	94-100
% Passing ¼″	60-88	55-92
% Passing No. 10	32-53	28-57
% Passing No. 40	11-24	9-27
% Passing No. 200	3.0-7.0	2.0-9.0
Fracture:		
Class A	90% Min.	85% Min.
Classes B & G	75% Min.	70% Min.
Class D		
1 Fractured Face	90% Min.	85% Min.
2 Fractured Faces	75% Min.	70% Min.
Classes E & F	50% Min.	45% Min.
Sand Equivalent:		
Classes A, B, D, E & G	40 Min.	35 Min.
Class F	35 Min.	30 Min.

Asphalt Treated Base

% Passing 2″	100	100
% Passing ½″	56-100	54-100
% Passing ¼″	40-78	35-83
% Passing No. 10	22-57	18-61
% Passing No. 40	8-32	5-35
% Passing No. 200	2.0-9.0	2.0-11.0
Sand Equivalent	35 Min.	

9-5.7 Sampling and Testing Frequency Guide — Metric

Item	Test	Acceptance Sample	Assurance Sample
Gravel Borrow	Grading & SE	1 – 4000 Tonnes	1 – 20,000 Tonnes
Select Borrow	Grading & SE	1 – 4000 Tonnes	1 – 20,000 Tonnes
Sand Drainage Blanket	Grading	1 – 4000 Tonnes	1 – 20,000 Tonnes
Gravel Base	Grading, SE & Dust Ratio	1 – 4000 Tonnes	1 – 20,000 Tonnes
CSTC	Grading, SE & Fracture	1 – 2000 Tonnes	1 – 10,000 Tonnes
CSBC	Grading, SE & Fracture	1 – 2000 Tonnes	1 – 10,000 Tonnes
Maintenance Rock	Grading, SE & Fracture	1 – 2000 Tonnes	1 – 10,000 Tonnes
Ballast	Grading, SE & Dust Ratio	1 – 2000 Tonnes	1 – 10,000 Tonnes
Shoulder Ballast	Grading & Fracture	1 – 2000 Tonnes	1 – 10,000 Tonnes
Backfill for Sand Drains	Grading	1 – 2000 Tonnes	1 – 10,000 Tonnes
Crushed CoversTonnese	Grading, SE & Fracture	1 – 1000 Tonnes	1 – 5,000 Tonnes
Crushed Screening			
⅝ – ¼	Grading & Fracture	1 – 1000 Tonnes	1 – 5,000 Tonnes
½ – ¼	Grading & Fracture	1 – 1000 Tonnes	1 – 5,000 Tonnes
¼ – 0	Grading & Fracture	1 – 1000 Tonnes	1 – 5,000 Tonnes
Gravel Backfill For			
Foundations	Grading, SE & Dust Ratio	1 – 1000 Tonnes	1 – 5,000 Tonnes
Walls	Grading, SE & Dust Ratio	1 – 1000 Tonnes	1 – 5,000 Tonnes
Pipe Bedding	Grading, SE & Dust Ratio	1 – 1000 Tonnes	1 – 5,000 Tonnes
Drains	Grading	1 – 100 Tonnes	1 – 500 Tonnes
PCC Paving			
Coarse Aggregate	Grading	1 – 2000 Tonnes	1 – 10,000 Tonnes
Fine Aggregate	Grading	1 – 1000 Tonnes	1 – 5,000 Tonnes
Core	Density	1 – 2000 m^2	
	Thickness	1 – 2000 m^2	
Completed Mix			
Consistency	Slump	1 – 2000 m^2	1 – 20,000 m^2
Air Content	Air	1 – 2000 m^2	1 – 20,000 m^2
Yield	Cement Factor	1 – 2000 m^2	1 – 20,000 m^2
Test Beam	Flexural Strength	1 – 2000 m^2	1 – 20,000 m^2
PCC Structures			
Coarse Aggregate	Grading	1 – 1,000 Tonnes	1 – 5,000 Tonnes
Fine Aggregate	Grading	1 – 500 Tonnes	1 – 2,500 Tonnes
Consistency	Slump	1 – 40 m^3	1 – 800 m^3
Air Content	Air	1 – 40 m^3	1 – 800 m^3
Cylinders (28-day)	Compressive Strength	1 – 40 m^3	1 – 800 m^3
Yield	Cement Factor	1 – 80 m^3	1 – 800 m^3
Cement	Chemical & Physical	Certification	(Verification Sample) 1 – 1,000 Tonnes

Note that if acceptance samples are taken more frequently than shown, the number of assurance samples will increase as one assurance sample and test is required for each five acceptance samples and tests for all aggregates.

Item	*Test*	*Acceptance Sample*	*Assurance Sample*
Asphalt Cement Concrete			
Completed Mix	Grading & Asphalt Content	1 – 800 Tonne***	****
	Compaction	5 – 400 Tonne (Min 1/Project)	
Open Graded, Class D and D Mod.	Grading (Agg. from cold feed)	1 – 800 Tonne***	
Asphalt Concrete Aggregate			
Aggregate (from cold feed)	SE & Fracture	1 – 1,600 Tonne (every other mix sample)***	
Coarse Aggregate (in stockpile)*	Grading, SE, & Fracture	1 – 1,000 Tonne	
Fine Aggregate (in stockpile)*	Grading, SE, & Fracture	1 – 1,000 Tonne	
Blend Sand (in stockpile)	SE	1 – 1,000 Tonne	
Mineral Filler	Sp. G & Pl	Certificate	
Asphalt Treated Base			
Aggregate	Grading* & SE	1 – 1,000 Tonne	
Completed Mix	Grading & Asphalt	1 – 1,000 Tonne	
	Compaction	5 – Control Lot**	
Asphalt Materials		Certification	Verification
Paving Asphalt (AR, AC, PBA)			1 L every 3rd shipment
Liquid Asphalt (Cutback, Emulsion)			1 L every other shipment
Emulsion for ACP Tack Coat			None required
Rubberized Asphalt		Certification	
Compaction			
Embankment		1 – 2000 M^3	
Cut Section		1 – 150 M	
Surfacing		1 – 300 M (per layer)	
Backfill		1 – 400 M^3	

* Tests for grading will be performed only when aggregates are being produced and stockpiled for use on a future project.

** A control lot shall be a normal days production. For minor quantities of 200 tonnes or less per day, a minimum of two gauge readings shall be taken.

*** For projects under statistical acceptance, the sample frequency shall be as prescribed in the contract, and the sublot size may vary from 500 to 800 tonnes depending on the project quantities. For projects under nonstatistical acceptance, the sublot size may vary from 400 to 800 tonnes with a minimum of one sublot per day when the daily production is less than 400 tonnes.

**** Mix design conformation samples shall be submitted to the Olympic Service Center bituminous concrete laboratory. For all mix designs, submit one sample for each five days production from each plant. For Initial (not Reference) mix designs, submit additional samples, one per day from the first five days of production for each plant.

9-5.7 Sampling and Testing Frequency Guide — English

Item	Test	Acceptance Sample	Assurance Sample
Gravel Borrow	Grading & SE	1 – 4000 Ton	1 – 20,000 Ton
Select Borrow	Grading & SE	1 – 4000 Ton	1 – 20,000 Ton
Sand Drainage Blanket	Grading	1 – 4000 Ton	1 – 20,000 Ton
Gravel Base	Grading, SE & Dust Ratio	1 – 4000 Ton	1 – 20,000 Ton
CSTC	Grading, SE & Fracture	1 – 2000 Ton	1 – 10,000 Ton
CSBC	Grading, SE & Fracture	1 – 2000 Ton	1 – 10,000 Ton
Maintenance Rock	Grading, SE & Fracture	1 – 2000 Ton	1 – 10,000 Ton
Ballast	Grading, SE & Dust Ratio	1 – 2000 Ton	1 – 10,000 Ton
Shoulder Ballast	Grading & Fracture	1 – 2000 Ton	1 – 10,000 Ton
Backfill for Sand Drains	Grading	1 – 2000 Ton	1 – 10,000 Ton
Crushed Coverstone	Grading, SE & Fracture	1 – 1000 Ton	1 – 5,000 Ton
Crushed Screening			
⅝ – ¼	Grading & Fracture	1 – 1000 Ton	1 – 5,000 Ton
½ – ¼	Grading & Fracture	1 – 1000 Ton	1 – 5,000 Ton
¼ – 0	Grading & Fracture	1 – 1000 Ton	1 – 5,000 Ton
Gravel Backfill For			
Foundations	Grading, SE & Dust Ratio	1 – 1000 Ton	1 – 5,000 Ton
Walls	Grading, SE & Dust Ratio	1 – 1000 Ton	1 – 5,000 Ton
Pipe Bedding	Grading, SE & Dust Ratio	1 – 1000 Ton	1 – 5,000 Ton
Drains	Grading	1 – 100 Ton	1 – 500 Ton
PCC Paving			
Coarse Aggregate	Grading	1 – 2000 Ton	1 – 10,000 Ton
Fine Aggregate	Grading	1 – 1000 Ton	1 – 5,000 Ton
Core	Density	1 – 2500 SY	
	Thickness	1 – 2500 SY	
Completed Mix			
Consistency	Slump	1 – 2500 SY	1 – 25,000 SY
Air Content	Air	1 – 2500 SY	1 – 25,000 SY
Yield	Cement Factor	1 – 2500 SY	1 – 25,000 SY
Test Beam	Flexural Strength	1 – 2500 SY	1 – 25,000 SY
PCC Structures			
Coarse Aggregate	Grading	1 – 1,000 Ton	1 – 5,000 Ton
Fine Aggregate	Grading	1 – 500 Ton	1 – 2,500 Ton
Consistency	Slump	1 – 50 CY	1 – 1,000 CY
Air Content	Air	1 – 50 CY	1 – 1,000 CY
Cylinders (28-day)	Compressive Strength	1 – 50 CY	1 – 1,000 CY
Yield	Cement Factor	1 – 100 CY	1 – 1,000 CY
Cement	Chemical & Physical	Certification	(Verification Sample) 1 – 1,000 Ton

Note that if acceptance samples are taken more frequently than shown, the number of assurance samples will increase as one assurance sample and test is required for each five acceptance samples and tests for all aggregates.

Item	*Test*	*Acceptance Sample*	*Assurance Sample*
Asphalt Cement Concrete			
Completed Mix	Grading & Asphalt Content	1 – 800 Ton***	****
	Compaction	5 – 400 Ton (Min 1/Project)	
Open Graded, Class D and D Mod.	Grading (Agg. from cold feed)	1 – 800 Ton***	
Asphalt Concrete Aggregate			
Aggregate (from cold feed)	SE & Fracture	1 – 1,600 Ton (every other mix sample)***	
Coarse Aggregate (in stockpile)*	Grading, SE, & Fracture	1 – 1,000 Ton	
Fine Aggregate (in stockpile)*	Grading, SE, & Fracture	1 – 1,000 Ton	
Blend Sand (in stockpile)	SE	1 – 1,000 Ton	
Mineral Filler	Sp. G & Pl	Certificate	
Asphalt Treated Base			
Aggregate	Grading* & SE	1 – 1,000 Ton	
Completed Mix	Grading & Asphalt	1 – 1,000 Ton	
	Compaction	5 – Control Lot**	
Asphalt Materials		Certification	Verification
Paving Asphalt (AR, AC, PBA)			1 qt. every 3rd shipment
Liquid Asphalt (Cutback, Emulsion)			1 qt. every other shipment
Emulsion for ACP Tack Coat			None required
Rubberized Asphalt		Certification	
Compaction			
Embankment		1 – 2,500 CY	
Cut Section		1 – 500 LF	
Surfacing		1 – 1,000 LF (per layer)	
Backfill		1 – 500 CY	

* Tests for grading will be performed only when aggregates are being produced and stockpiled for use on a future project.

** A control lot shall be a normal days production. For minor quantities of 200 tons or less per day, a minimum of two gauge readings shall be taken.

*** For projects under statistical acceptance, the sample frequency shall be as prescribed in the contract, and the sublot size may vary from 500 to 800 tons depending on the project quantities. For projects under nonstatistical acceptance, the sublot size may vary from 400 to 800 tons with a minimum of one sublot per day when the daily production is less than 400 tons.

**** Mix design conformation samples shall be submitted to the Olympic Service Center bituminous concrete laboratory. For all mix designs, submit one sample for each five days production from each plant. For Initial (not Reference) mix designs, submit additional samples, one per day from the first five days of production for each plant.

9-5.7A Sampling and Testing Frequency Guide for Independent Assurance Samples — Metric

Item	*Test*	*Frequency of Sampling and Testing*
Gravel Borrow Gravel Base Sand Drainage Blanket	Grading & SE Grading, SE & Dust Ratio Grading	1 sample per 80,000 tonnes with 1 sample on each project requiring 30,000 tonnes or more and/or 2 or more assurance samples.
Crushed Surfacing Base Course Top Course Ballast Shoulder Ballast Maintenance Rock Backfill for Sand Drains	Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE	1 sample per 40,000 tonnes with 1 sample on each project requiring 15,000 tonnes or more and/or 2 or more assurance samples.
Crushed Coverstone	Grading, SE & Fracture	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.
Crushed Screenings ⅝ — ¼ ½ — ¼ ¼ — 0	Grading, SE & Fracture	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.
Gravel Backfill for Foundations Walls Pipe Bedding	 Grading, SE & Dust Ratio Grading, SE & Dust Ratio Grading, SE & Dust Ratio	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.
Drains	Grading	1 sample per 2,000 tonnes with 1 sample on each project requiring 750 tonnes or more and/or 2 or more assurance samples.
PCC Paving Coarse Aggregate	 Grading	1 sample per 40,000 tonnes with 1 sample on each project requiring 15,000 tonnes or more and/or 2 or more assurance samples.
Fine Aggregate	Grading	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.

Item	*Test*	*Frequency of Sampling and Testing*
PCC Structure		
Coarse Aggregate	Grading	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.
Fine Aggregate	Grading	1 sample per 10,000 tonnes with 1 sample on each project requiring 3,750 tonnes or more and/or 2 or more assurance samples.
Asphalt Cement Concrete		
Coarse Aggregate Fine Aggregate	SE, Fracture & Physical	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 or more assurance samples.
Blend Sand		None required.
Mineral Filler		None required.
Asphalt Treated Base		
Coarse Aggregate Fine Aggregate	Grading, SE	1 sample per 20,000 tonnes with 1 sample on each project requiring 7,500 tonnes or more and/or 2 more assurance samples.
Completed Mix		
ACP and ATB	Grading & Asphalt Content	1 sample per 20,000 tonnes with 1 sample on each project requiring 2,000 tonnes or more and/or 2 or more assurance samples.

9-5.7A Sampling and Testing Frequency Guide for Independent Assurance Samples — English

Item	*Test*	*Frequency of Sampling and Testing*
Gravel Borrow Gravel Base Sand Drainage Blanket	Grading & SE Grading, SE & Dust Ratio Grading	1 sample per 80,000 tons with 1 sample on each project requiring 30,000 tons or more and/or 2 or more assurance samples.
Crushed Surfacing Base Course Top Course Ballast Shoulder Ballast Maintenance Rock Backfill for Sand Drains	Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE Grading & SE	1 sample per 40,000 tons with 1 sample on each project requiring 15,000 tons or more and/or 2 or more assurance samples.
Crushed Coverstone	Grading, SE & Fracture	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.
Crushed Screenings ⅝ — ¼ ½ — ¼ ¼ — 0	Grading, SE & Fracture	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.
Gravel Backfill for Foundations Walls Pipe Bedding	 Grading, SE & Dust Ratio Grading, SE & Dust Ratio Grading, SE & Dust Ratio	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.
Drains	Grading	1 sample per 2,000 tons with 1 sample on each project requiring 750 tons or more and/or 2 or more assurance samples.
PCC Paving Coarse Aggregate	 Grading	1 sample per 40,000 tons with 1 sample on each project requiring 15,000 tons or more and/or 2 or more assurance samples.
Fine Aggregate	Grading	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.

Item	*Test*	*Frequency of Sampling and Testing*
PCC Structure		
Coarse Aggregate	Grading	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.
Fine Aggregate	Grading	1 sample per 10,000 tons with 1 sample on each project requiring 3,750 tons or more and/or 2 or more assurance samples.
Asphalt Cement Concrete		
Coarse Aggregate Fine Aggregate	SE, Fracture & Physical	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 or more assurance samples.
Blend Sand		None required.
Mineral Filler		None required.
Asphalt Treated Base		
Coarse Aggregate Fine Aggregate	Grading, SE	1 sample per 20,000 tons with 1 sample on each project requiring 7,500 tons or more and/or 2 more assurance samples.
Completed Mix		
ACP and ATB	Grading & Asphalt Content	1 sample per 20,000 tons with 1 sample on each project requiring 2,000 tons or more and/or 2 or more assurance samples.

9-5.7B Sampling and Testing Frequency Guide for Tests to be Witnessed by the Independent Assurance Sampler

Subgrade Compaction: (Includes Cut Sections and Backfill Zones.)	One test per 40,000 cubic meters (50,000 cubic yards) with one test on each project requiring 20,000 cubic meters (25,000 cubic yards) or more of embankment compaction.
Surfacing Compaction: (Includes Gravel Base.)	One test per 40,000 tonnes (50,000 tons) with one test on each project requiring 20,000 tonnes (25,000 tons) or more surfacing.
Asphalt Pavement Compaction:	One lot of compaction test for each Independent Assurance sample of completed mix.
Asphalt Materials Paving Asphalt (inc. emulsified asphalt used in Open Graded Asphalt) Emulsified Asphalt for BST Cut-back Asphalt for BST	Witness Project Inspector taking verification sample.

9-5.7C Sampling and Testing Frequency Guide for Tests to be Taken by the Independent Assurance Sampler

PCC PAVING: Slump Air Content Cement Factor Compressive Strength (Cylinders)	1 of each test using independent equipment, to be made along side of acceptance tests. 1 set of tests per 20,000 cubic meters (25,000 cubic yards) with 1 set of tests on each project requiring 1,000 cubic meters (1,250 cubic yards) or more.
PCC STRUCTURES: Slump Air Content Cement Factor Compressive Strength (Cylinders)	1 of each test using independent equipment, to be made along side of acceptance tests. 1 set of tests per 800 cubic meters (1,000 cubic yards) with 1 set of tests on each project requiring 40 cubic meters (50 cubic yards) or more.

9-6 Radioactive Testing Devices

9-6.1 Administration and Safety

The purpose of this chapter is to provide a guide for personnel using, and administering the use of, testing devices containing radioactive materials. The instructions included in this Chapter will be used throughout the Washington State Department of Transportation for the express purpose of regulating the use of radioactive testing devices containing radioactive materials.

Each Region shall have a Region Radiation Administration Officer and a Region Radiation Safety Officer whose duties are described in Chapter 9-6.2 and 9-6.3. Only licensed operators shall operate radioactive testing devices. A licensed operator, whose responsibilities are described in Chapter 9-6.4 must complete a certified training course to be eligible for a license.

All personnel using or responsible for radioactive testing devices shall be:

1. Thoroughly familiar with the safe handling techniques for using radioactive materials.

2. Fully informed of the hazards to health that exist near radioactive materials.

3. Completely familiar and in compliance with the following rules and regulations:

    a. Rules and Regulations for Radiation Protection by the State Department of Health, Division of Radiation Protection, Title 246, WAC.

    b. Radiation Emergency Handbook by the State Department of Health.

Copies of the above publications will be kept by the Region Radiation Safety Officer. A copy of the *Radiation Emergency Handbook* will also be supplied with each radioactive testing device. The Licensed Operator will read this handbook before using the radioactive testing device for testing.

If an emergency as outlined in the *Radiation Emergency Handbook* occurs, the following people or agencies should be notified by the individual in charge of the testing device:

1. Radiation Control Program; Health Services Division; State Department of Health; Olympia, Washington 98504 (Phone 206/NUCLEAR).

2. Washington State Patrol, if a public hazard exists.

3. Radiation Administration Officer.

4. Radiation Safety Officer.

5. Olympia Service Center Radiation Administration Officer or Radiation Safety Officer.

The telephone numbers of these agencies or individuals will be posted at all storage sites and a copy of these numbers shall be kept with each device.

Personal monitoring of radiation received from the radioactive testing device is one of the major items in the Health Safety Program. Anyone handling radioactive sources must wear a radiation exposure badge which records any exposure that the body may receive. Radiation exposure badges are assigned to individuals. They are not to be used by any other person.

The acquisition of radiation exposure badges as needed by each Region shall be the responsibility of the Region Radiation Safety Officer. These badges can be obtained from U.S. Dosimetry Technology Inc., 660-A George Washington Way, Richland, Washington 99352, Telephone (509) 946-8738, or from a firm recognized by the Department of Health to perform this service. Three month TLD (Thermo Luminescent Dosimeter) badges indicating exposure to gamma, beta, x-ray, and neutron radiation will be used.

Each radioactive testing device will be supplied in a shipping container with an adequate latch. For transporting purposes, this latch and the lock on the testing device must be secured. At all times, the key for the lock will be in the possession of the individual responsible for the radioactive testing device.

When a passenger vehicle is used for transporting, the box containing the testing device shall be kept in the trunk. When a station wagon or panel truck is used, the testing device shall be placed at the back of the vehicle in such a manner as to prevent it from sliding around. When carried in a six passenger pickup with a service body, the testing device shall be carried in the back, with the storage lid locked. Don't carry the testing device in the back seat. When a pickup is used, the box containing the testing device will be secured to the bed of the vehicle to prevent movement and in such a way as not to be removed by a passerby.

For en route overnight storage at a motel, hotel, or other lodging place, the locked testing device may be left in the locked vehicle. In case of a pickup truck, the testing device must be locked in the cab of the truck.

9-6.2 Radiation Administration Officer (Region Materials Engineer)

The Radiation Administration Officer (RAO) will be responsible for administering the use of radioactive material within the Region.

The RAO will obtain, revise, and renew the Region's Radioactive Material License issued by the Washington State Department of Health. A license indicates the strength and type of sources that a Region may possess.

Licenses are issued subject to all the requirements of the Washington Rules and Regulations for Radiation Protection and to the conditions specified in the license. Licenses are also subject to any additional requirements of the Department of Health as stated in letters issued by DOH. Where a letter containing a license condition requirement differs from the Regulations, the letter will supersede the regulations insofar as the license is concerned.

When a change occurs in the radiation program which would make untrue a statement in the current Radioactive Material License, the Licensee will notify the Department of Health and request an appropriate amendment.

The Radiation Administration and Safety Officers must be listed on the license. Individual operators are not required to be on the license, but the Radiation Administration Officer must maintain a list of licensed or qualified operators. This list of qualified operators should include the operator's name, type of training, and final test score.

The RAO will be responsible for the storage of the radioactive testing devices when not in field use, and the assignment of testing devices to the individual project offices. The RAO will be responsible for maintaining the following records:

1. List of qualified operators within the Region.
2. Radioactive testing device location records.
3. Radioactive testing device shipping records.

Prior to shipping (or transferring) the testing device from one licensed organization to another, the shipper shall check, and be assured, that the receiver has a valid license; and that the shipped (or transferred) sources do not exceed the limitations of the receiver's license. Shipment to authorized personnel within the Region is covered by the Region's license. Any radioactive testing device requiring repairs or calibration will be shipped to the Olympia Service Center Materials Laboratory. They will make the arrangement to have the testing device repaired.

The RAO is responsible to arrange for the training of licensed operators. The RAO will arrange for the training classes to be conducted and maintain the training records for the region.

When the testing devices are not in field use, the normal storage will be at the Region office. This should be an area designated for this purpose with the following information posted on the walls of the room to notify personnel of the existence of radiation:

1. "CAUTION — RADIOACTIVE MATERIALS" sign.

2. DOH Form RHF-3 "Notice to Employees."

3. Chapters 246-220, 246-221, and 246-222 of the *Rules and Regulations for Radiation Protection*.

4. DOH Form "Notification of a Radiation Emergency."

9-6.3 Radiation Safety Officer (Assurance Inspector or Equal)

The Radiation Safety Officer (RSO) will have the responsibility for the Region radiation protection program. The RSO will be responsible for maintaining the following records:

1. Wipe test records.

2. Medical records.

3. Radiation Exposure Report.

4. Minor testing device maintenance as outlined in the Radioactive Materials License.

Wipe tests or leak testing is required by law and is simply a swabbing of the sealed source to ascertain that no radioactive contamination has occurred from the nuclear source. The Region RSO shall be responsible for having each source wiped every six months. The analysis of wipe tests is done by a commercial firm licensed to do this work. The service contract will be obtained by individual regions. Records of leak tests results shall be kept in units of microcuries and maintained for inspection. Any leak test revealing the presence of 0.005 microcuries or more of removable radioactive material shall be reported to the Department of Health, Radiation Control Division, LD-11 Olympia, Washington 98504, within five days of the test. This report should include a description of the defective source or device, the results of the test, and the corrective action taken.

Leak test kits can be obtained from Troxler Electronic Laboratory, Inc. When returning the sample for testing, place the sample in a plastic envelope. Place the plastic envelope(s) in another envelope and write your company name, address, and other pertinent details on the outside. This envelope must be marked "RADIOACTIVE MATERIALS — NO LABEL REQUIRED."

Place this envelope into another envelope addressed to the approved facility for processing. Prior to being mailed, the contents and packing must be checked with a survey instrument and the radiation at any point on the surface must not exceed a dose rate greater than 0.5 millirem per hour in order to comply with U.S. Postal Regulations.

The radiation Safety Officer will be responsible for radiation exposure reports for the personnel in that Region. Exposure records shall be kept on Department of Health Form RFH-5 or in a manner which includes all information required on said form. Each entry shall be for a period of time not exceeding one calendar quarter.

9-6.4 Licensed Operators

The Licensed Operators will be directly responsible to the Radiation Administration Officer for the use and storage of the radioactive testing device in the field and to the Radiation Safety Officer for all safety in regard to the radioactive testing device.

The Licensed Operators shall be responsible for posting the following information at all field storage areas:

1. "CAUTION — RADIOACTIVE MATERIALS" Sign.

2. DOH Form RHF-3 "Notice to Employees."

3. Chapters 246-220, 246-221, and 246-222 of the *Rules and Regulations for Radiation Protection*.

4. DOH Form "Notification of a Radiation Emergency."

The Licensed Operator must keep the Radiation Administration Officer informed of the location of the radioactive sources at all times. (The State Radiation Control Unit inspectors will want the sources produced or the exact locations given during their periodic inspections.) If the exact location where the testing device will be used is known in advance, it should be noted before leaving the Region office, and if unknown, shall be forwarded to the Radiation Administrative Officer as soon as it is known.

The Licensed Operator on a project must know (for the nuclear density gauge) how the shutter operating device for shielding the radioactive materials works as the source index handle is moved. The operation of the shutter operating device should be continuously checked and any malfunction reported to the Radiation Administration Officer immediately. When not in use, the source index handle will be locked and the nuclear density gauge locked in an adequate storage facility. When operating the nuclear gauge (i.e., when the handle is in the "USE" position), unauthorized personnel are not to be within 2 meters (5 feet) of the gauge.

9-7 Vacant

9-8 WSDOT Test Methods/FOP for AASHTO No.

Where applicable Field Operating Procedures (FOP) for the AASHTO or ASTM test methods listed have been adopted. These FOP's are technically equavalent abridged versions of the complete AASHTO or ASTM Test Methods. In absense of a FOP for an AASHTO or ASTM test method the current WSDOT test method is listed.

WSDOT	AASHTO	Field Operating Procedure
102	T11	Materials Finer than 75um (No. 200) Sieve in Mineral Aggregates by Washing
103		Method for Determining Percent of Fracture in Aggregates
104	T27	Sieve Analysis of Fine and Course Aggregates
106	T255	Total Moisture Content of Aggregate by Drying
109	T176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
116	T248	Reducing Field Samples of Aggregates to Testing Size (Untreated)
123		Method of Test for Bark Mulch
210	T40	Sampling Bituminous Materials
413		Method of Test for Evaluating Water-proofing Effectiveness of Membrane and Membrane-Pavement Systems
609	T99	The Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
613		Method for Determining In-Place Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/ Density Gauge
705	T209	Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures — "Rice Density"
713		Method of Test for moisture in Bituminous Mixtures
712		Standard Method of Sampling Bituminous Paving Mixtures
715		Method of Test for Relative Compaction of Asphalt Concrete Pavement
716		Method of Random Sampling for Location of Testing and Sampling Sites
722		Method of Test for Determination of Asphalt Content by Nuclear Method
723		Method of Test for Quick Determination of Aggregate Gradation Using Alternate Solvent
725		Method of Test for Field Verification of a Job Mix Calibration for the Nuclear Asphalt Content Gauge
802		Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
803	T141	Sampling Freshly Mixed Concrete
804	T119	Slump of Hydraulic Cement Concrete
805	T152	Air Content of Freshly Mixed Concrete by the Pressure Method
806	T121	Weight Per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete
807		Method of Operation of California Profilograph and Evaluation of Profiles
808		Method of Making Flexural Test Beams
809	T23	Making and Curing Concrete Test Specimens in the Field
813		Field Method of Fabrication of 2-inch Cube Specimens for Compressive Strength Testing of Grouts and Mortars
914		Practice for Sampling Geotextiles for Testing
	T2	Sampling of Aggregates
	T272	Family of Curves — One Point Method
ASTM		
C 1064		Method for Determination of the Temperature of Freshly Mixed Concrete
C 805		Method for Determination of Concrete Strength by Rebound Number
D 1186		Nondestructive Measurement of Thickness of Nonmagnetic Coating on a Ferrous Base

9-8.1 Calibrated/Verified Equipment

The following listed equipment is required to be verified and/or calibrated annually when used for acceptance testing:

Aggreagate Testing Module

Drying ovens (AASHTO T-255, 265)

General purpose balances,scales and weights (AASHTO M-231)

Mechanical sieve shaker (AASHTO T-27)

Sand equivalent shaker (AASHTO T-176)

Sand equivalent weighted foot assembly (AASHTO T-176)

Sieves (AASHTO M-92)

Thermometers ASTM 113 C or F (to check drying temperature)

Timing devices (AASHTO T-176)

Asphalt Testing Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Ignition Oven

Mechanical sieve shaker (AASHTO T-27)

Sieves (AASHTO M-92)

Thermometer — ASTM 17 C or F (Rice Test)

Thermometer — ASTM 113 C or F (to check drying temperature)

Timing devices (AASHTO T-209)

Vacuum system (AASHTO T-209)

Water bath — if used (AASHTO T-209)

Structural Concrete Testing Module

Concrete air meters — pressure gauge (AASHTO T-152)

Concrete air meters — volumetric gauge (AASHTO T-152)

Cube molds and tamper (AASHTO T106)

General purpose balances, scales and weights (AASHTO M-231)

Rebound hammer Type N (ASTM C-805)

Single Use Molds (AASHTO M-205)

Slump cone (AASHTO T-119)

Thermometer — ASTM 97 C or F (concrete temperature)

Unit weight measures (AASHTO T-19)

Density Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Manual hammer (AASHTO T-99)

Nuclear density gauge (Troxler 3400 series gauge)

Sieves (AASHTO M-92)

Soil mold (AASHTO T-99)

Straightedge (AASHTO T-99)

Density Standards Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Manual hammer (AASHTO T-99)

Mechanical sieve shaker (AASHTO T-27)

Sieves (AASHTO M-92)

Soil mold (AASHTO T-99)

Straightedge (AASHTO T-99)

These pieces of equipment shall bear a tag indicating when calibrated or verified will expire. In addition to the equipment listed additional equipment will needed, such as an assortment of pans, spoons, brushes, spatulas, etc. It is the responsibility of the testing personnel (i.e., Interm or Qualified Testers and Independent Assurance Inspectors) to check all equipment for servicability and confromance to the requirements of the test procedure.

9-7.3 Project Record Documents

Project record measurements and materials certification must be completed before the project will be considered acceptable by the Assistant Secretary for Field Operations Support Service Center. Materials which are questionable, or measured thicknesses which are deficient beyond tolerance, must be explained by the Project Engineer.
An explanation must be supported by copies of field tests, with comments pertaining to corrective action and disposition of substandard materials. Copies of field measurements taken at the time material is placed, as required in Chapter 4-4.4 of this manual, will be required to support explanation of thickness deficiencies. The explanations and data provided by the Project Engineer may become part of the certification to the Federal Highway Administration.

9-8 WSDOT Test Methods/FOP for AASHTO No.

Where applicable Field Operating Procedures (FOP) for the AASHTO or ASTM test methods listed have been adopted. These FOP's are technically equavalent abridged versions of the complete AASHTO or ASTM Test Methods. In absense of a FOP for an AASHTO or ASTM test method the current WSDOT test method is listed.

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609	T99	The Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
613		Method for Determining In-Place Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/Density Gauge
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713		Method of Test for moisture in Bituminous Mixtures
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725		Method of Test for Field Verification of a Job Mix Calibration for the Nuclear Asphalt Content Gauge
802		Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
803	T141	Sampling Freshly Mixed Concrete
804	T119	Slump of Hydraulic Cement Concrete
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807		Method of Operation of California Profilograph and Evaluation of Profiles
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813		Field Method of Fabrication of 2-inch Cube Specimens for Compressive Strength Testing of Grouts and Mortars
914		Practice for Sampling Geotextiles for Testing
	T2	Sampling of Aggregates
	T272	Family of Curves — One Point Method
		ASTM C 1064 — Method for Determination of the Temperature of Freshly Mixed Concrete
		ASTM C 805 — Method for Determination of Concrete Strength by Rebound Number
		ASTM D 1186 — Nondestructive Measurement of Thickness of Nonmagnetic Coating on a Ferrous Base

9-8.1 Calibrated/Verified Equipment

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Aggreagate Testing Module

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General purpose balances,scales and weights (AASHTO M-231)

Mechanical sieve shaker (AASHTO T-27)

Sand equivalent shaker (AASHTO T-176)

Sand equivalent weighted foot assembly (AASHTO T-176)

Sieves (AASHTO M-92)

Thermometers ASTM 113 C or F (to check drying temperature)

Timing devices (AASHTO T-176)

Asphalt Testing Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Ignition Oven

Mechanical sieve shaker (AASHTO T-27)

Sieves (AASHTO M-92)

Thermometer — ASTM 17 C or F (Rice Test)

Thermometer — ASTM 113 C or F (to check drying temperature)

Timing devices (AASHTO T-209)

Vacuum system (AASHTO T-209)

Water bath — if used (AASHTO T-209)

Structural Concrete Testing Module

Concrete air meters — pressure gauge (AASHTO T-152)

Concrete air meters — volumetric gauge (AASHTO T-152)

Cube molds and tamper (AASHTO T106)

General purpose balances, scales and weights (AASHTO M-231)

Rebound hammer Type N (ASTM C-805)

Single Use Molds (AASHTO M-205)

Slump cone (AASHTO T-119)

Thermometer — ASTM 97 C or F (concrete temperature)

Unit weight measures (AASHTO T-19)

Density Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Manual hammer (AASHTO T-99)

Nuclear density gauge (Troxler 3400 series gauge)

Sieves (AASHTO M-92)

Soil mold (AASHTO T-99)

Straightedge (AASHTO T-99)

Density Standards Module

Drying ovens (AASHTO T-255, 265)

General purpose balances, scales and weights (AASHTO M-231)

Manual hammer (AASHTO T-99)

Mechanical sieve shaker (AASHTO T-27)

Sieves (AASHTO M-92)

Soil mold (AASHTO T-99)

Straightedge (AASHTO T-99)

These pieces of equipment shall bear a tag indicating when calibrated or verified will expire. In addition to the equipment listed additional equipment will needed, such as an assortment of pans, spoons, brushes, spatulas, etc. It is the responsibility of the testing personnel (i.e., Interm or Qualified Testers and Independent Assurance Inspectors) to check all equipment for servicability and confromance to the requirements of the test procedure.

FOP for AASHTO T 11 and T 27

Method of Test for Sieve Analysis of Fine and Coarse Aggregates Including Wet Sieve

General Description

This procedure is used to determine the distribution of particles in a graded aggregate. If the amount of material passing the 75 µm (U.S. No. 200) sieve is required, the procedure for washing the sample prior to the sieve analysis must be done.

1000 µm = 1 mm

1. The following equipment will be needed:

   a. Scale — Capable of the minimum masses (weights) shown in Table 1 sensitive to 0.1 percent of the mass of the sample, or 0.2 grams.

   b. Sieves.

   c. Mechanical sieve shaker.

   d. Suitable Drying Source — See FOP for AASHTO T255

   e. Containers and Utensils — A pan or vessel of a size sufficient to contain the sample covered with water and to permit vigorous agitation without loss of any part of the sample or water.

2. Sample Sizes

   Sample the aggregate (FOP AASHTO T 2) and reduce (FOP AASHTO T 248) to the minimum sizes given in Table 1, unless otherwise specified.

Table 1

Maximum Size of Particle	***Minimum Weight of Sample***	
	kg	***lb.***
mm (in.)	***A***	***A***
10 (⅜)	1	2
13 (½)	2	4
19 (¾)	2 ½	5
25 (1)	5	10
38 (1 ½)	8	15
51 (2)	10	20
64 (2 ½)	12	25
76 (3)	15	30
89 (3 ½)	20	40

3. Procedure

   a. Dry the sample to a constant mass (weight) and record.

   b. When the specification requires that the amount of material finer than the 75 µm (U.S. No. 200) sieve be determined do c. through i. otherwise skip to j.

Note: If the applicable specification requires that the amount passing the 75 μm (U.S. No. 200) sieve shall be determined on a portion of the sample passing a sieve smaller than the nominal maximum size of the aggregate, separate the sample on the designated sieve and weight the material passing the designated sieve to 0.1 percent of the weight of this portion of the test sample. Use the weight as the original dry weight of the test sample.

c. Nest two sieves together, such as 2 mm (U.S. No. 10) above a 75 μm (U.S. No. 200).

d. After drying and weighing, place the test sample in the container and add sufficient water to cover it.

Note: A detergent, dispensing agent, or other wetting solution may be added to the water to assure a thorough separation of the material finer than the 75 μm (U.S. No. 200) sieve from the coarser particles.

e. Agitate the sample with sufficient vigor to result in complete separation of the material finer than the 75 μm (U.S. No. 200) sieve from the coarser particles, resulting in complete separation of all particles, and bring the fine material into suspension.

f. Immediately pour the waste water containing the suspended and dissolved solids over the nested sieves.

g. Add a second change of water to the sample in the container, agitate, and decant as before. Repeat the operation until the wash water is reasonably clear.

h. Return all material retained on the nested sieves by flushing into the washed sample.

i. Dry the washed aggregated to constant weight (allow aggregate to cool prior to shaking).

j. Nest the sieves specified in order of decreasing size of opening from top to bottom and place the sample on the top sieve.

k. Place sieves in mechanical shaker and shake for a minimum of 10 minutes.

Note: Continue shaking for a sufficient period and in such manner that, after completion, not more than 0.5 percent by weight of the total sample passes any sieve during one minute of continuous hand salvo, provided with a snug-fitting pan and cover, in a slightly include position in one hand. Strike the side of sieve sharply an with an upward motion against the heel of the other hand at he rate of about 150 times per minute, turn the sieve about one sixth of a revolving at intervals of about 25 strokes. In determined sufficiency of sieving for sizes larger than the 4.75 mm (U.S. No. 4) sieve, limit the material on the sieve to a single layer of particles.

For sieves with openings smaller than 4.75 mm (U.S. No. 4), the mass retained on any sieve shall not exceed 6 kg/m^2 (4 $g/in.^2$) of sieving surface. For sieves with openings a 4.75 mm (U.S. No. 4) and larger, the mass in kg/m2 of sieving surface shall not exceed the product of $2.5 \times$ (sieve opening in mm).

In the case of coarse and fine aggregate mixtures, the portion of the sample finer than the 4.75 mm (U.S. No. 4) sieve may be distributed among two or more sets of sieves to prevent overloading of individual sieves.

Alternatively, the portion finer than the 4.75 mm (U.S. No. 4) sieve may be reduced in size using a mechanical splitter according to T 248.

l. Remove and weight the material on each sieve.

Note: The total weight of the material after sieving should check closely with original weight of sample placed on the sieves. If the amounts differ by more than 0.3 percent, based on the original dry sample weight, the results should not be used for acceptance purposes.

m. Divide the weights on the individual sieves by the initial dry weight (prior to washing), determine the amount of material passing each sieve.

Note: Calculate the percentage retained to the nearest 0.1 percent and the percent passing to that called for in the specifications.

4. CALCULATION

a. Calculate percent on the basis of the total mass (weight) of the sample, including any material finer than the 75 µm (U.S. No. 200) sieve which was washed out as described in paragraph 3.b. and 3.c. above.

When material passing 4.75 mm (U.S. No. 4) sieve is split and only a portion of that is tested, the proportionate share of the amount passing the 75 mm (U.S. No. 200) sieve as determined above must be added to the sample mass to obtain a corrected test mass (weight). This corrected test mass is used to calculate the gradation of the material passing the 4.75 mm (U.S. No. 4) sieve.

Example: Showing calculations when the 4.75 mm — 0 is split.

Dry mass (weight) of total sample, before washing or sieving: 3214 g
Dry mass (weight) of sample, after washing out some of the 75 µm (U.S. No. 200) minus: 3085 g
Amount of 75 µm (U.S. No. 200) minus washed out: 3214 g – 3085 g = 129 g

Sieve on Coarse Screens

Sieve	(G) Accum. Mass (Weight) Ret.	% Ret.	% Pass
16 mm (⅝ in.)	0	0	100
12.5 mm (½ in.)	161	5	95
9.5 mm (⅜ in.)	642	20	80
4.75 mm (U.S. No. 4)	1117	35	65
pan	3085		
corrected pan	3214	100	0

Note: 3085 g was the actual mass of material retained in the pan, but 129 g was added to compensate for the 129 g of 75 µm minus which was washed out. The corrected pan mass is: 3085 g + 129 g = 3214 g. This 3214 g is the mass used to calculate the percent retained for the coarse screens.

The actual mass (weight) of material passing the 4.75 mm (U.S. No. 4) and retained in the pan is 3085 g – 1117 g = 1968 g. Take this 1968 g and split it down, and sieve:

Sieve	(G) Accum. Weight Ret.	Percent Ret.	Percent Pass
4.75 mm (U.S. No 4)	0	0	100
2.00 mm (U.S. No. 10)	196.5	38	62
425 µm (U.S. No. 40)	376.2	72	28
210 µm (U.S. No. 80)	433.7	83	17
75 µm (U.S. No 200)	480.5	92.2	7.8
pan	489.3		
corrected pan	521.4	100	0

Note: The 489.3 g was the actual mass (weight) of the split of the 4.75 mm (U.S. No. 4) minus that was run. It represents (489.3 / 1,968) × 100 = 24.9 percent of the 4.75 mm (U.S. No. 4) minus, not including the 75 µm (U.S. No. 200) minus that was washed out. Therefore, the pan weight must be corrected to include the proper percent of 75 µm (U.S. No. 200) minus that was washed out.

Corrected pan mass (weight) = $A + \frac{A \times C}{B} = 489.3\ g + \frac{489.3\ (129g)}{1{,}968g} = 521.4\ g$

A = accumulated mass (weight) of material retained in the pan from the split of the 4.75 mm (U.S. No. 4) minus

B = mass (weight) of the 4.75 mm (U.S. No. 4) minus of entire sample, not including 75 µm (U.S. No. 200) minus washed out

C = mass (weight) of 75 µm (U.S. No. 200) minus washed out

This “corrected pan mass (weight)” is the mass (weight) used to calculate the percent retained for the fine grading, as shown above.

Finally, correct the fine grading percent passing by multiplying by the percent passing the 4.75 mm (U.S. No. 4) during the coarse grading:

	Fine Grading Percent Passing		Final Percent Passing
16 mm (⅝ in.)			100
12.5 mm (½ in.)			95
9.5 mm (⅜ in.)			80
6.3 mm (¼ in.)	100	× .65 =	65
2.0 mm (10 in.)	62	× .65 =	40
425 µm (40 in.)	28	× .65 =	18
210 µm (80 in.)	17	× .65 =	11
75 µm (200 in.)	7.8	× .65 =	5.1

5. REPORT

a. The results shall be reported on DOT Form 422-020 or DOT Form 350-062 and shall include the following:

(1) Total percent of material passing each sieve.

(2) Total mass of material retained on each sieve.

(3) Percent of material retained between consecutive sieves, depending upon the form of the specifications for use of the material under test. Report percent to the nearest whole number except for the percent passing the 75 μm (U.S. No. 200) sieve which shall be reported to the nearest 0.1 percent.

23:P:DP/MM

WSDOT Test Method No. 103

Method for Determining Percent of Fracture in Aggregates

1. SCOPE

   a. This method covers the procedures for determining the percent of fracture in aggregates. Fractured aggregate is defined in the *Standard Specifications* as follows: "Fractured aggregate is defined as aggregate particles which have one or more fractured faces. A face will be counted as fractured whenever one-half or more of the projected area of the particle is comprised of a fractured face when viewed normal to the fractured face." The fracture will apply to material retained on each specified sieve 2.00 mm (U.S. No. 10) and above if that sieve retained more than 5 percent of the total material as stated in the *Standard Specifications*.

   To assist in evaluating the fracture the following definition should be used:

   "A fractured face is characterized by the visible presence of the crystalline mineral structure of the rock on an approximately plane surface, the area of which comprises more than one-half of the projected area of the particle when viewed normal to the plane surface."

2. EQUIPMENT

   a. Sieves conforming to *Specifications for Sieves for Testing Purposes.*

   b. A spatula, spoon, or other similar instrument.

   c. Balances — For fine aggregate, the balance shall have a capacity of at least 200 g and be sensitive to 0.1 g; for coarse aggregate, the balance shall have a capacity of at least 5000 g and be sensitive to 1 g.

3. PROCEDURE

   a. Sieve the sample through the specified sieves.

   b. Select a representative portion from each sieve specified for gradation or fracture by splitting or quartering (see Table 1).

   c. Spread a selected portion of the sample from a sieve on a well-lighted, flat surface, and using the spatula or spoon, or the fingers, separate the particles with fractured faces as defined in Section 1 above. Consult the specifications for the material being tested to determine whether additional separation is required for particles having two fractured faces.

   d. Weigh the separated materials.

   e. Repeat Steps c. and d. for each selected portion from each sieve.

Table 1

The approximate recommended weight of the portions for fracture determination are:

Retained on 31.5 mm Sieve (1 ¼ in. sieve) 1500 g
Retained on 25 mm Sieve (1 in. sieve) 1000 g
Retained on 16 mm Sieve (⅝ in. sieve) 500 g
Retained on 12.5 mm Sieve (½ in. sieve) 300 g
Retained on 9.5 mm Sieve (⅜ in. sieve) 200 g
Retained on 6.3 mm or 4.75 mm Sieve (U.S. No. 4 sieve) 100 g
Retained on 2.36 mm or 2.00 mm Sieve (U.S. No. 8 or No. 10 sieve) 25 g

4. CALCULATIONS

a. Determine the percent of fracture for each specified sieve using the following formula:

$$\frac{\text{Weight of fractured particles in portion}}{\text{Total mass of portion}} \times 100\%$$

b. Alternate Method

For better separation, it is sometimes helpful to use extra sieves during the screen analysis. For example, place the 9.5 mm (⅜ in.) sieve between the 12.5 mm (½ in.) and 4.75 mm (¼ in.) sieves on aggregate gradation for Class "E" Asphalt Concrete. When this is done, the fracture must be counted on each sieve and reported as the mass average for all sieves used between specified sieves. The method for determining mass average is shown by the following example:

To determine fracture of 12.5 mm (½ in.) to 4.75 mm (¼ in.) material where 9.5 mm (⅜ in.) sieve is used:

Material between 12.5 mm (½ in.) and 9.5 mm (⅜ in.) = 11.7 percent total sample and is 70 percent fractured.

Material between 9.5 mm (⅜ in.) and 4.75 mm (¼ in.) = 21.0 percent total sample and is 90 percent fractured.

$$\frac{(11.7 \times 70) + (21.0 \times 90)}{11.7 + 21.0} = \frac{819 + 1890}{32.7}$$ = 82.8 percent fracture for 12.5 mm (½ in.) to 4.75 mm (¼ in.)

c. Alternate Method

After separating the material using extra sieves, the material retained on the intermediate sieves may be added to the material retained on the next smaller specified sieve. This material is to be thoroughly mixed then quartered or split to an approximate mass as shown in Table 1. The fracture will be counted and reported for the specified sieve.

5. REPORTS

a. Report percent of fracture on DOT Form 422-020 (Inspector's Record of Field Test) or DOT Form 350-062 or where appropriate. Report the percent fracture for each sieve specified.

3:P:DP/MM

WSDOT FOP for AASHTO T 255

Method of Test for Moisture Content of Construction Materials

General Notes

Use the sample sizes and drying methods specified for the individual test procedures being run.

1. EQUIPMENT

   The following equipment may be needed based on the method specified:

   a. Scale accurate to 0.1 g.

   b. Containers, capable of being sealed.

   c. Microwave safe containers.

   d. Thermometer, reads to 205°C (400°F) accurate to ± 6°C (± 10°F).

   e. Forced air oven (Gilson BO 350).

   f. Microwave oven (600 watts minimum).

   g. Conventional oven.

   h. Infrared propane heater, hot plate, fry pan, or any other device that will dry the sample, without altering the material being dried.

   i. Utensils, such as spoons; hot pads or gloves, etc.

2. APPLIES TO ALL METHODS

   Immediately seal or cover samples to prevent any change in moisture content, if the total moisture content of the material is required.

3. DRYING PROCEDURES

   a. Forced air oven method.

      (1) Spread the sample of the material in a tared container and record the total weight.

      (2) Dry the material to constant mass (weight) in the oven at 171°C ± 6°C (340 ± 10°F).

      (3) Record the dry mass (weight).

   b. Microwave oven method.

      (1) Place the sample of the material in a tared container, heaped to form a large mass in the center, and record the total mass (weight).

      (2) Set the power setting on the oven to a position that will heat the sample to 171° ± 6°C (340° ± 10°F) as soon as possible. This setting will normally be on high.

      (3) When the sample reaches 171°C (340°F), reset the oven to hold this temperature.

      (4) After 10 minutes at 171° ± 6°C (340° ± 10°F) , remove the sample, mass (weight) and record.

      (5) Place the sample back in the oven for another 10 minutes, being sure to hold the temperature noted in (4).

      (6) Remove the sample, weigh, and record.

(7) Continue the procedure noted in (5) and (6). until there is no loss in mass (weight) (0.2 g or less loss is considered dry).

(8) Record the dry mass (weight).

c. Conventional oven method.

(1) Place the sample of the material into a tared container and record the mass (weight).

(2) Dry the material to constant mass (weight) in the oven at 110° ± 6°C (230° ± 10°F) (approximately 24 hours).

(3) Record the dry mass (weight).

d. Any method or drying source.

Note: This method allows the use of any suitable drying source listed, when the material is dried for other tests or the method is sufficiently accurate for the type of material being tested.

(1) Weigh the sample in a tared container, if required.

(2) Dry to a constant mass (weight) stirring the sample to accelerate the removal of moisture. Constant mass (weight) is defined as, less than 1 g loss or less than 0.1 percent loss after an additional 30 minutes of drying.

(3) Record the mass (weight) if required.

4. CALCULATIONS

Calculate the percent moisture using the following formula:

$$\text{Percent Moisture} = \frac{\text{wet mass (weight)} - \text{dry mass (weight)}}{\text{dry mass (weight)}} \times 100$$

5. ASPHALT MIXTURE SAMPLE SIZES

Table 1

Maximum Designated Particle Size	***Moisture Content Sample***
1 in. or less	500 ± 50 g
1 in. plus	1000 ± 100 g

14:P:DP/MM

FOP for AASHTO T 176

Method of test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

1. SCOPE

   a. This procedure is intended to serve as a rapid test to show the relative proportions of fine dust or claylike materials in graded fine aggregates and soils.

2. APPARATUS

   For a detailed listing of sand equivalent apparatus see AASHTO T 176 “Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test” Figure 1, with the exception that the siphon tube and blow tube may be glass or stainless steel as well as copper.

   a. A graduated plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly and siphon assembly. Fit the siphon assembly to a 4-L (1-gal.) (unbreakable) bottle of working calcium chloride solution placed on a shelf 915 mm ± 25 mm (36 in. ± 1 in.) above the work surface.

      Note: There are two models of the weighted foot assembly in use, the older model has a guide cap that fits over the upper end of the graduated cylinder and centers the rod in the cylinder. It is read using a slot in the centering screws. The newer model has a sand reading indicator 256.5 mm (10 in.) above this point and is preferred for testing clayey materials.

   b. Measuring Can — 3 ounce size having a capacity of 85 ± 5 ml.

   c. Funnel — A wide-mouth funnel for transferring sample into graduated cylinder.

   d. Quartering Cloth — 600 mm (2 LF) square nonabsorbant cloth, such as plastic or oil cloth.

   e. Mechanical Splitter — See FOP for AASHTO T 248.

   f. Strike Off Bar — Straight edge or spatula.

   g. Clock or Watch — A timepiece reading in minutes and seconds.

   h. Manually Operated Sand Equivalent Shaker — Capable of producing an oscillating motion at a rate of 100 complete cycles in 45 ± 5 seconds, with a hand assisted stroke length of 127 ± 5 mm (5 ± 2 in.). It may be held stable by hand during the shaking operation. It is recommended that this shaker be fastened securely to a firm and level mount, by bolts or clamps if a large number of determinations are to be made.

   j. Mechanical Shaker — See AASHTO T 176 for equipment and procedure.

   k. Oven — Capable of maintaining a temperature of 110° ± 5°C (230° ± 9°F).

3. MATERIALS

   a. Obtain commercially prepared calcium chloride stock solution

   b. Working calcium chloride solution. Prepare the working calcium chloride solution by diluting one measuring tin full (85 ± 5 ml) of the stock calcium chloride solution to 3.8 L (1 gal.) with water. (The graduated cylinder filled to 4.4 in. contains 88 ml.) Use distilled or demineralized water for the preparation of the working solution.

      Note: The shelf life of the working solution is 30 days and must be replaced at that time.

4. CONTROL

a. Extreme care must be used in all stages of preparation of the material to be tested in order to maintain the integrity of the sample. It is necessary to prevent the loss of fines during sieving and splitting operations, spray a light mist of water from a spray bottle while hand mixing to slightly dampen the sample prior to sieving. Do not moisten to the point the fines will cling to the sieves or splitter.

b. The temperature of the working solution should be maintained at 22° ± 3°C (72° ± 5°F) during the performance of the test. If field conditions preclude the maintenance of the temperature range, frequent referee samples should be submitted to Region Laboratory or FOSSC laboratory where proper temperature control is possible. Samples which meet the minimum sand equivalent requirement at a working solution temperature outside of the temperature range need not be subject to referee testing.

5. SAMPLE PREPARATION

Note: Experiments show that as the amount of material being reduced by splitting or quartering is decreased, the accuracy of providing representative portions is reduced. It is imperative that the sample be split or quartered carefully. When it appears necessary, dampen the material before spliting or quartering, to avoid segregation or loss of fines.

a. Obtain the sample per FOP for AASHTO T 2 and reduce per FOP for AASHTO T 248. Determination of sand equivalent is based on the results of two (2) samples.

b. Prepare sand equivalent test samples from the passing 4.75 mm (U.S. No. 4) portion of the material to be tested. If the material is in clods it will need to be broken up and rescreened over the 4.75 mm (U.S. No. 4) sieve, and all fines shall be cleaned from particles retained on the 4.75 mm (U.S. No. 4) sieve and included with the material passing the 4.75 mm (U.S. No. 4) sieve.

Note: If the material is air dried prior to obtaining the passing 4.75 mm (U.S. No. 4) portion, be careful not to exceed 60°C (140°F).

c. Split of quarter 1000 to 1500 g of material from the passing 4.75 mm (U.S. No. 4) portion. If necessary, dampen the material to avoid segregation or loss of fines prior to splitting and quartering. Use extreme care in the test sample preparation to obtain a truly representative portion of the original sample.

d. The sample must be in the proper moisture condition to achieve reliable results. This condition is determined by tightly squeezing a small portion of the thoroughly mixed sample in the palm of the hand. If the cast that is formed permits careful handling without breaking, the correct moisture range has been obtained. If the material is too dry, the cast will crumble and it will necessary to add water and remix and retest until the material forms a cast.

Note: Sand for PCC may not form cast.

If the material shows any free water it is too wet to test and must be drained and air dried, mixing it frequently to ensure uniformity. This drying process should continue until a squeeze check on the drying material gives the required cast.

If the moisture content is altered to meet these limits, the altered sample should be placed in a pan, covered with a lid or with a sample cloth which does not touch the material, and allowed to stand for a minimum of 15 minutes. Sample that have been sieved without being air dried and still retain enough natural moisture are excluded from this tempering period.

e. Place the sample on the quartering cloth and mix by alternately lifting each corner of the cloth and pulling it over the sample toward the diagonally opposite corner, being careful to keep the top cloth parallel to the bottom and thus causing the material to be rolled. When the material appears homogeneous, finish the mixing with the sample in a pile near the center of the cloth.

f. Fill the 85 ml (3 oz.) tin measure by pushing it through the base of the pile while exerting pressure with the hand against the pile on the side opposite the measure.

As the tin is moved through the pile, hold enough pressure with the hand to cause the material to fill the tin to overflowing. Press firmly with the palm of the hand, compacting the material and allowing the maximum amount to be placed in the tin. Strike off the tin measure level full with the straight edge or spatula.

6. PROCEDURE

Note: Referee Method using "Pre-Wet" method as described in AASHTO T 176 is acceptable. This test must be performed in a location free of vibrations, as vibrations may cause the suspended material to settle at a rate greater than normal.

a. Start the siphon by forcing air into the top of the solution bottle through the blow tube while the pinch clamp is open. The apparatus is now ready for use.

b. Siphon 101.6 mm ± 2.5 mm (4.0 ± 0.1 in.) of working calcium chloride solution into the plastic cylinder. Pour the prepared test sample from the measuring tin into the plastic cylinder using the funnel to avoid spillage. Tap the bottom of the cylinder sharply on the heel of the hand several times to release air bubbles and to promote thorough wetting of the sample.

c. Allow the wetted sample to stand undisturbed for 10 ± 1 minute. At the end of the 10-minute soaking period, stopper the cylinder, then loosen the material from the bottom by partially inverting the cylinder and shaking it simultaneously.

d. After loosening the material from the bottom of the cylinder, shake the cylinder and contents by any one of the following methods:

(1) Manual Shaker Methods — Secure the stoppered cylinder in the three spring clamps on the carriage of the hand operated sand equivalent shaker and reset the stroke counter to zero. Stand directly in front of the shaker and force the pointer to the stroke limit marker painted on the backboard by applying an abrupt horizontal thrust to the upper portion of the right hand spring strap.

Then remove the hand from the strap and allow the spring action of the straps to move the carriage and cylinder in the opposite direction without assistance or hindrance. Apply enough force to the right hand spring steel strap during the thrust portion of each stroke to move the pointer to the stroke limit marker by pushing against the strap with the ends of the fingers to maintain a smooth oscillating motion. The center of the stroke limit marker is positioned to provide the proper stroke length and its width provides the maximum allowable limits of variation.

The proper shaking action is accomplished only when the tip of the pointer reverses direction within the marker limits. Proper shaking action can best be maintained by using only the forearm and wrist action to propel the shaker. Continue the shaking action for 100 strokes.

(2) Hand Method — Hold the cylinder in a horizontal position as illustrated in and shake it vigorously in a horizontal linear motion from end to end. Shake the cylinder 90 cycles in approximately 30 seconds using a throw of 229 mm ± 25 mm (9 ± 1 in.). A cycle is

defined as a complete back and forth motion. To properly shake the cylinder at this speed, it will be necessary for the operator to shake with the forearms only, relaxing the body and shoulders.

(3) Machanical Method — See AASHTO T 176.

e. Following the shaking operation, set the cylinder upright on the work table and remove the stopper.

f. Irrigation Procedure. Insert the irrigator tube in the cylinder and rinse material from the cylinder walls as the irrigator is lowered. Force the irrigator through the material to the bottom of the cylinder by applying a gentle stabbing and twisting action while the working solution flows from the irrigator tip. Work the irrigator tube to the bottom of the cylinder as quickly as possible, since it becomes more difficult to do this as the washing proceeds. This flushes the fine material into suspension above the coarser sand particles.

Continue to apply a stabbing and twisting action while flushing the fines upward until the cylinder is filled to the 381 mm (15 in.) mark. Then raise the irrigator slowly without shutting off the flow so that the liquid level is maintained at about 381 mm (15 in.) while the irrigator is being withdrawn. Regulate the flow just before the irrigator is entirely withdrawn and adjust the final level to 381 mm (15 in.).

Note: Occasionally the holes in the tip of the irrigator tube may become clogged by a particle of sand. If the obstruction cannot be freed by any other method, use a pin or other sharp object to force it out, using extreme care not to enlarge the size of the opening. Also keep the tip sharp as an aid to penetrating the sample.

g. Sedimentation — Allow the cylinder and contents to stand undisturbed for 20 minutes ± 15 seconds. Start the timing immediately after withdrawing the irrigator tube.

Note: Any vibration or movement of the cylinder during this time will interfere with the normal settling rate of the suspended clay and will cause an erroneous result.

h. Clay and Sand Readings

(1) At the end of the 20-minute sedimentation period, read and record the level of the top of the clay suspension. This is referred to as the clay reading.

Note: For WSDOT Material Acceptance

If no clear line of demarcation has formed at the end of the specified 20-minute sedimentation period, processed material will considered as failing to meet the minimum specified SE values.

(2) The following optional procedure may be used only with prior “Approval” of the FOSSC Material Laboratory. This approval is limited to “unprocessed” material from any given source.

(a) If no clear line of demarcation has formed at the end of the specification 20-minute sedimentation period, allow the sample to stand undisturbed until a clay reading can be obtained, then immediately read and record the level of the tope of the clay suspension and the total sedimentation time. If the total sedimentation time exceeds 30 minutes, rerun the test suing three individual samples of the same material. Read and record the clay column height of the sample requiring the shortest sedimentation period only.

(b) Once a sedimentation me has been established, all subsequent test will be run using that time. The time will be record along with the test results on all transmittals and results.

(2) After the clay reading has been taken, place the weighted foot assembly over the cylinder and gently lower the assembly over the cylinder and gently lower the assembly until it comes to rest on the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered. Subtract 254 mm (10 in.) from the level indicated by the extreme top edge of the indicator and record this value as the sand reading.

(3) If clay or sand readings fall between 2.5 mm (0.1 in.) graduations, record the level of the higher graduation as the reading. For example, a clay reading of 7.95 would be recorded as 8.0, a sand reading of 3.22 would be recorded as 3.3.

(4) If the two SE samples very by more than 8 points, addiitonal tests shall be run.

6. CALCULATIONS

a. Calculate the sand equivalent to the nearest 0.1 using the following formula:

$$SE = \frac{\text{Sand Reading} \times 100}{\text{Clay Reading}}$$

b. If the calculated sand equivalent is not a whole number, report it as the next higher whole number. For example, if the sand equivalent were calculated sand equivalent would be as follows:

$$SE = \frac{3.3}{8.0} \times 100 = 41.25$$

This calculated sand equivalent is not a whole number and it would be reported as the next higher whole number, which is 42.

c. In determining the average of the two samples, raise each calculated SE value to the next higher whole number as shown in the following example:

Calculated SE values: 41.3, 42.8

After raising each to the next higher whole number they become: 42, 43. The average of these values is then determined:

$$\frac{42 + 43}{2} = 42.5$$

Since the average value is not a whole number, it is raised to the next higher whole number and the reported average sand equivalent value is reported as “43.”

12:P:DP/MM

FOP for AASHTO T 2

Method of Test for Sampling Aggregates and Aggregate Mixtures

1. SCOPE

   This method covers sampling of fine and coarse aggregates.

   The specifications require the contractor to provide a mechanical sampling system at crushers and screening operations. This system is normally a permanently attached device that allows a sample container to pass perpendicularly through the entire stream of material or diverts the entire stream of material into the container. The sample container is normally larger at the bottom than the top (triangular shaped), with the slotted opening in the top based on the size aggregate being sampled.

   Operation may be hydraulic or pneumatic and shall allow the sample container to pass through the stream at least twice, once in each direction, without overfilling.

2. GENERAL PROCEDURE

   Sampling is equally as important as the testing, and the sampler shall use every precaution to obtain samples that will show the true nature and condition of the materials which the sample represents.

   a. Where ever samples are taken, obtain at least three approximately equal samples.

   b. Combine them to form a field sample which meets or exceeds the minimum weight recommended in Table 1.

3. SAMPLING LOCATIONS

   a. Conveyor Belts

      (1) The belt is stopped and a sampling device is set in place on it to avoid intrusion by adjacent material. The sample is scooped off and all fines are swept off into the sample.

      (2) A container is passed through the full stream of the material as it is running off the end of the belt.

      Note: A mechanical sampling device attached to the end product belt is the most appropriate method to insure representative samples.

   b. Transport Units

      (1) Divide the unit into four quarters, dig down approximately one foot in each quarter to obtain the sample. Combine to form a single sample.

   c. Roadways (road mixed bases or subbases)

      (1) Obtain the sample from the berm after the last mixing pass and prior to spreading and compacting.

   d. Stockpiles

      Note: Avoid sampling at stockpiles whenever possible due to problems involved in obtaining the representative gradation of coarse or combined coarse and fine material.

      (1) If a loader is available, create an exposed face or if material has already been removed, take samples at various levels and locations along the vertical face.

      (2) When there is no equipment available to expose a face, take at least three samples. One from the top, middle, and bottom of the pile and combine.

Note: Shoving a flat board in above the sampling point aids in preventing further segregation.

(3) When sampling sand, remove the outer layer which may have become segregated and using a sample tube, obtain samples from five random locations around the pile, and combine to form the sample.

Table 1: Sample Sizes

Item	*Weight/Mass per Sample*
Select Borrow	75 lbs./35 kg
Gravel Borrow	50 lbs./25 kg
Sand Drainage Blanket	50 lbs./25 kg
Gravel Base	50 lbs./25 kg
CSTC	50 lbs./25 kg
CSBC	50 lbs./25 kg
Maintenance Rock	30 lbs./15 kg
Ballast	50 lbs./25 kg
Shoulder Ballast	50 lbs./25 kg
Backfill for Sand Drains	50 lbs./25 kg
Coverstone	30 lbs./15 kg
Cr. Screenings	30 lbs./15 kg
Gravel Backfill	50 lbs./25 kg
PCC Coarse Aggregate	50 lbs./25 kg
PCC Fine Aggregate	5 lbs./2 kg
Asphalt Treated Base	
Aggregate	25 lbs./12 kg
Asphalt Cement Concrete	
Coarse Aggregate	25 lbs./12 kg
Fine Aggregate	25 lbs./12 kg
Blending Sand	15 lbs./8 kg
Mineral Filler	3 lbs./1 kg

11:P:DP/MM

WSDOT FOP for AASHTO T 40

Standard Method of Test for Sampling Bituminous Liquids

General Notes

Samples of these liquids are taken to verify specification compliance. Care must be taken when handling to avoid contamination. These samples are usually taken from storage tanks or the vehicles used for hauling or applying the liquid.

Sample containers must be new and may not be washed or rinsed clean. The outside of the container may be wiped with a clean, dry cloth.

1. PROCEDURE

   Note: Draw off a minimum of 4-L (1-gal.) from the sample valve before obtaining samples:

   Paving Plants

   Obtain the samples from the line between the storage tank and the mixing plant while the plant is in operation, or from the vehicle used for delivery.

   Distributors, etc.

   If the bituminous liquid has not been diluted, obtain the sample directly from the spray bar or application device, otherwise, sample at delivery or prior to dilution.

2. CONTAINERS

   Note: All samples shall be in 1-L (1-qt.) containers and properly identified on the outside of the container with contract number, date sampled, data sheet number, brand and grade of material, and sample number. Include lot and sublot numbers when appropriate.

   a. For emulsified asphalt samples use wide mouth plastic jars with screw caps (available from storeroom). Label with date sampled.

      Note: Since water is a part of the emulsion, protect the samples from freezing.

   b. For all other liquids use metal cans.

15:P:DP/MM

WSDOT FOP for AASHTO T 209

Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures — "Rice Density"

1. SCOPE

   a. This method covers the determination of the maximum sp. gr. of uncompacted bituminous paving mixtures. This method is technically equivalent to AASHTO T 209.

2. APPARATUS

   a. Balance, with ample capacity, and with sufficient sensitivity to enable maximum sp. gr. of samples of uncompacted paving mixtures to be calculated to at least four significant figures; that is, to at least three decimal places.

   b. Container — A volumetric flask.

   c. Vacuum pump or water aspirator, for evacuating air from the container.

   d. Water Bath — A constant-temperature water bath (optional).

   e. Thermometers — Calibrated liquid-in-glass, or electronic digital total immersion type, accurate to 0.1°C.

3. CALIBRATION OF FLASK

   a. The volumetric flask will be calibrated periodically in conformance with established verification procedures, contact regional lab.

4. TEST SAMPLES

   a. The sample shall be obtained in accordance with WSDOT Test Method No. 712, Sampling Bituminous Paving Mixtures.

   b. The size of the sample shall conform to the requirements of Table 1. Samples larger than the capacity of the container may be tested a portion at a time.

Table 1: Size of Sample

Class of Mix	Minimum Size Sample in Grams
A	1000
B	1000
D	500
E	2000
F	1500
G	500
ATB (16 mm (⅝ in. minus) minus)	1500
ATB (50 mm (2 in. minus) minus)	2000

5. PROCEDURE

a. Separate the particles of the sample, taking care not to fracture the mineral particles, so that the particles of the fine aggregate portion are not larger than 6.3 mm (¼ in.). If the mixture is not sufficiently soft to be separated manually, place it in a large flat pan and warm in an oven only until it can be so handled.

b. Cool the sample to room temperature, place in the flask, and weigh. Designate the net mass (weight) of sample as a. Add sufficient water at approximately 25°C (77°F) to cover the sample.

c. Remove entrapped air by subjecting the contents to a partial vacuum of 30 mm Hg or less absolute pressure for a period of 15 ± 2 minutes. A partial vacuum of 30 mm Hg absolute pressure is approximately equivalent to 730 mm Hg reading on a vacuum gauge at sea level. Agitate the container and contents either continuously by mechanical device or manually by vigorous shaking at intervals of about two minutes. The release of entrapped air may be facilitated by the addition of a suitable wetting agent such as Aerosol OT in concentration of 0.01 percent or 1 ml of 10 percent solution in 1,000 ml of water.

d. Fill the flask with water and bring the contents to a temperature of 25° ± 0.5°C (77 ± 1°F) in a constant-temperature water bath. Determine the weight of flask (filled) and contents 10 ± 1 minute after completing c.

e. In lieu of a constant temperature water bath, determine the temperature of the water within the flask and determine the mass of the flask (filled) and the contents 10 ± 1 minutes after completing c. Make the appropriate density correction to 25°C (77°F) using Table 2.

6. CALCULATION

a. Calculate the Rice sp. gr. (calculate to three decimal places) of the sample as follows:

(1) Determination at 25°C (77°F):

$$\text{Rice Sp. Gr.} = \frac{A}{A + D - E} \times R$$

where:

A = Mass (weight) of dry sample in air, in grams,

D = Mass (weight) of flask filled with water at 25°C (77°F) in grams, and

E = Mass (weight) of flask filled with water and sample at 25°C (77°F) in grams.

(2) Determination using temperature correction:

$$\text{Rice Sp. Gr.} = \frac{A}{A + D - E} \times R$$

where:

A = Mass (weight) of dry sample in air, in grams,

D = Mass (weight) of flask filled with water at 25°C (77°F) in grams,

E = Mass (weight) of flask filled with water and sample at test temperature in grams, and

R = Factor from Table 2 to correct density of water from the test temperature to 25°C (77°F).

Note: The flask calibration is done at 25°C (77°F).

b. Calculate the rice density (calculate to one decimal place):

(1) Rice density = Rice sp. gr. × 997 kg/m^3 (62.24 lb/ft.^{3})

Table 2: Temperature Correction Factor

C°	"R"	C°	"R"
10	1.00267	25	1.000
10.6	1.00262	25.6	.99984
11.1	1.00256	26.1	.99971
11.7	1.00249	26.7	.99955
12.2	1.00244	27.2	.99941
12.8	1.00236	27.3	.99925
13.3	1.00228	28.3	.99910
13.9	1.00222	28.9	.99893
14.4	1.00215	29.4	.99878
15	1.00207	30	.99860
15.6	1.00198	30.6	.99842
16.1	1.00189	31.1	.99826
16.7	1.00179	31.7	.99807
17.2	1.00167	32.2	.99791
17.7	1.00159	32.8	.99771
18.3	1.00149	33.3	.99755
18.9	1.00138	33.9	.99735
19.4	1.00130	34.4	.99716
20	1.00116	35	.99698
20.6	1.00104	35.6	.99677
21.1	1.00093	36.1	.99659
21.7	1.00080	36.7	.99638
22.2	1.00068	37.2	.99621
22.8	1.00054	37.8	.99598
23.3	1.00042	38.3	.99579
23.9	1.00027	38.9	.99558
24.4	1.00015	39.4	.99539
		40	.99516

7. SUPPLEMENTAL PROCEDURE FOR MIXTURES CONTAINING POROUS AGGREGATE NOT COMPLETELY COATED

a. If the pores of the aggregates are not thoroughly sealed by a bituminous film, they may become saturated with water during the evacuation procedure. To determine if this has occurred, proceed as follows after completing the procedure in accordance with paragraph 5d. Drain water from sample. To prevent loss of fine particles, decant water through a towel held over top of container. Break several large pieces of aggregate and examine broken surfaces for wetness.

b. If aggregate has absorbed water, spread sample before an electric fan to remove surface moisture. Weigh at 15-minute intervals and when the loss in mass is less than 0.5 g for this interval, the sample may be considered to be surface dry. This procedure requires about two hours and should be accompanied by intermittent stirring of the sample. Conglomerations of mixture should be broken by hand. Care must be taken to prevent loss of particles of mixture.

c. To calculate the sp. gr. of the sample, the final surface-dry mass (weight) is substituted for A in the denominator of Paragraph 6(A)(1) or 6(A)(2).

16:P:DP/MM

WSDOT Test Method No. 712

Standard Method of Sampling and Reducing Bituminous Paving Mixtures

1. SCOPE

   These methods cover the procedures for acceptance and assurance sampling and reduction of bituminous mixtures with mineral aggregate as prepared for use in paving. These methods are similar to AASHTO T 168, T 248. The samples will be used to represent an average of the bituminous mixture.

2. SAMPLING

   a. Selection of Samples

      (1) Sampling and reduction of these samples are equally as important as the testing and every precaution should be taken to obtain a truly representative sample of bituminous mixture.

      (2) Care shall be taken to prevent contamination of mixture by dust or foreign matter and to avoid segregation of coarse aggregate and bituminous materials.

      (3) Samples of bituminous mixtures upon which acceptance or rejection of the lot is to be based shall be selected by the engineer or authorized representative in accordance with the applicable procedure outlined herein.

   b. Test Sample Sizes

      The size of sample shall be as prescribed in succeeding paragraphs.

   c. Sampling Plant-mixed Bituminous Mixtures at the Place of Manufacture

      (1) Samples from a hauling vehicle shall be taken from at least four points, approximately 300 mm (12 in.) below the surface, of each quadrant of load (see diagram). Not less than 45 kg (100 lbs.) of material shall be taken in this manner and the portions shall be mixed and reduced by as described herein to the required size of sample.

Truck Box

X	X
X	X

X= sample location

      (2) Samples shall be taken at the frequency specified in Chapter 9-5.7 of the *Construction Manual*.

   d. Sampling Plant-Mixed Bituminous Mixtures From Roadway

      On occasion, sampling of bituminous paving mixtures at the plant site may not be practical. In such cases, the acceptance and assurance sampling of the paving mixture may be taken from the roadway behind the paving machine. Not less than one sample shall be taken for each day's run.

e. Identification of Samples

(1) Each sample submitted to the laboratory shall be accompanied by a transmittal letter (DOT Form 350-056) completed in detail. Include the contract number, acceptance and assurance test numbers Mix I.D. number, Nuclear Calibration number, class of mix, aggregate pit-source number, and asphalt grade and supplier name.

(2) The samples shall be submitted in standard 200 mm × 200 mm × 200 mm (8 in. × 8 in. × 8 in.) sample boxes. Each container shall be filled to capacity and secured in a way to prevent spillage.

(3) The Contract number, acceptance and assurance numbers, class of mix, asphalt grade, and sample number, and date shall be inscribed on the container with an indelible-type marker.

(4) The required samples to be forwarded on a daily basis unless unusual circumstances necessitates a less frequent schedule.

3. REDUCTION OF SAMPLES

a. Apparatus

Apparatus shall consist of a flat-bottomed scoop, shovel, straightedge metal plate or quartering device, a broom or brush, a trowel, and a canvas blanket or heavy paper or other suitable material of appropriate size and strength to handle the sample to be reduced.

b. Procedure (for approximately 45 kg (100 lbs.) field samples)

(1) Place the hot bituminous sample on a suitable, dry surface where there will be neither loss of material nor accidental addition of foreign material. The surface may be covered with either a canvas blanket, heavy paper or other suitable material. Remove the sample from the containers by dumping in a conical pile. DO NOT REMIX the sample.

(2) Quarter the material using a straightedge metal plate or suitable quartering devise.

(3) Use one of the quarters to fill the AC gauge pan and obtain a minimum 500 gm. moisture sample. Retain the remaining material from this quarter. The opposing quarter will be used for a gradation and rice density sample.

(4) The remaining quarters are to be used for assurance testing and should be boxed and shipped to the Regional and Service Center labs when required.

c. Procedure (for approximately 11 kg (25 lbs.) field or lab samples)

This is a standard procedure for use on all classes of bituminous mix.

(1) Place the hot bituminous sample on a suitable, dry surface where there will be neither loss of material nor accidental addition of foreign material. The surface may be covered with either a canvas blanket, heavy paper or other suitable material. Mix the material thoroughly by turning the entire sample over three times. Alternately lift each corner of the blanket or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposing corners to form a conical pile carefully flatten the pile to uniform thickness and diameter.

(2) Quarter the material using a straightedge metal plate or suitable quartering devise.

Prepare the sample as described by Section 3b sheet metal splitter works best to separate to quarters. Identify each quarter (Figure 1-1).

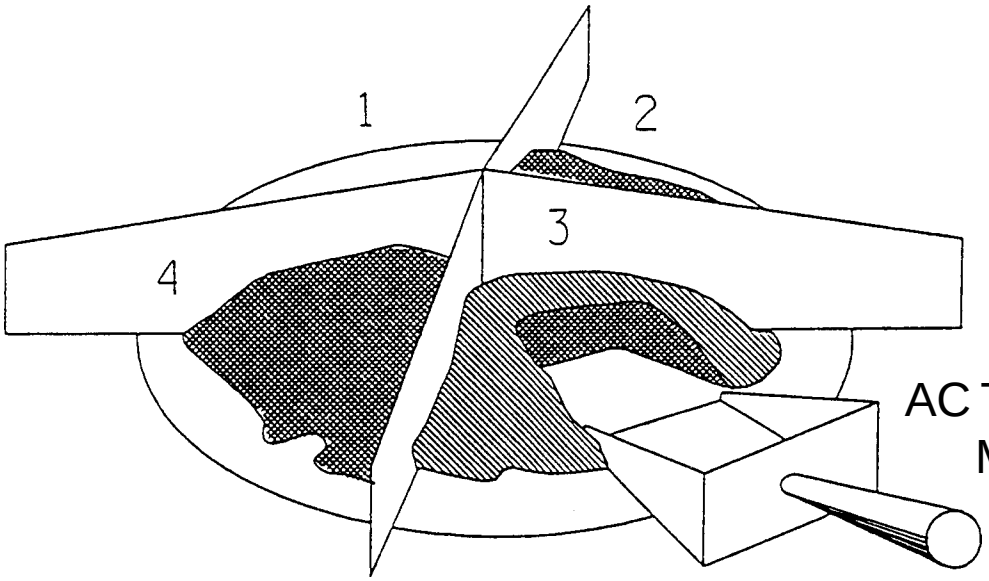


Figure 1-1

Pick a quarter for your Asphalt Content Sample. Remove enough material from the quarter to fill asphalt content pan to required weight. At the same time, remove a minimum of 500 grams from the selected quarter for moisture content determination. Place excess material in box for use as a backup sample if needed.

Place untouched quarters in sample boxes. These will be used for assurance testing if required (Figure 1-2).

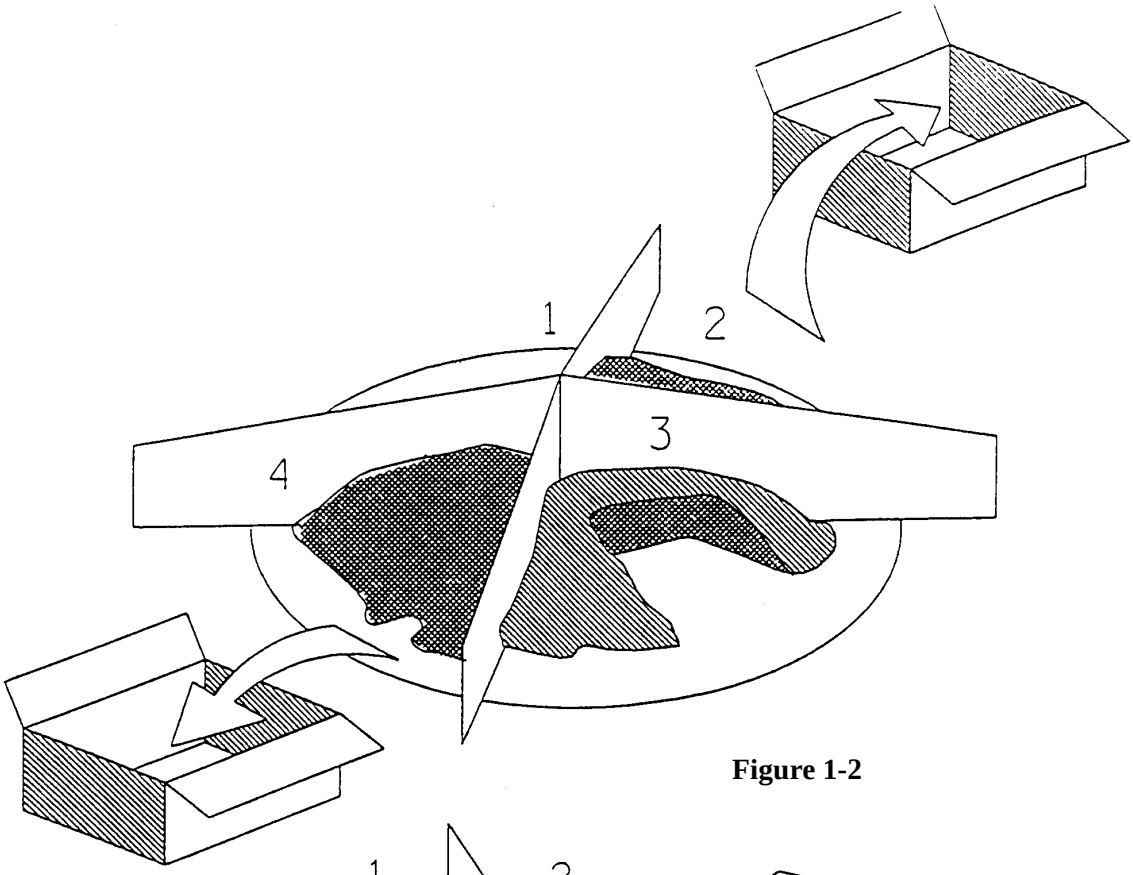


Figure 1-2

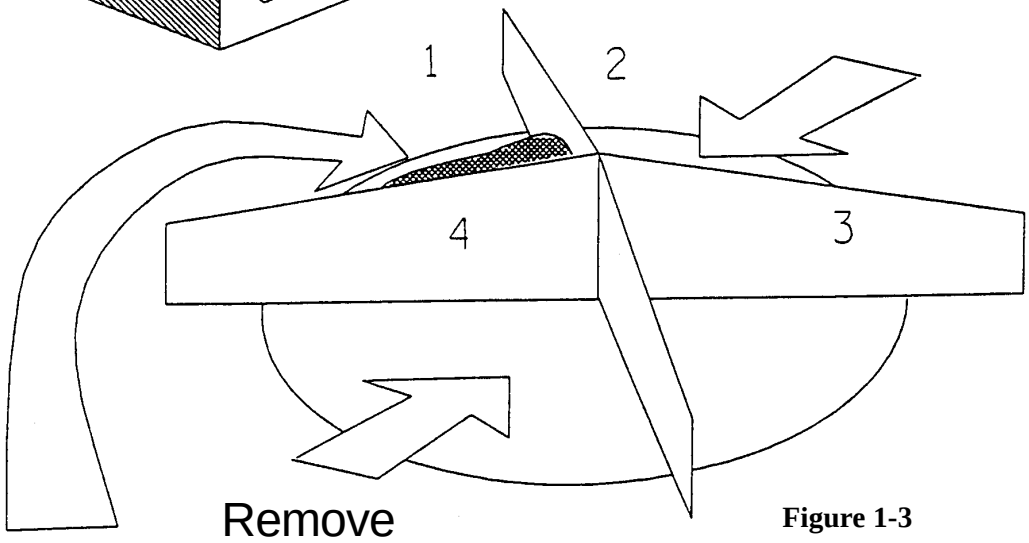


Figure 1-3

Use the opposite quarter to obtain samples for gradation and rice. Place excess material in box for use as backup sample if needed.

(3) If required, use two opposing quarters to fill the AC content pan and obtain a minimum 500 gm moisture sample. Return any additional material from these two quarters to the sample container.

(4) For additional samples combine the remaining two quarters and repeat steps (A and B). Remove two opposing quarters, being careful to clean the fines from the surface. Successively repeat this process until the desired sample size is achieved.

d. Optional Procedure (for approximately 11 kg (25 lbs.) field or lab samples)

Note: This is an optional "loaf" procedure for use on material with a 19 mm (¾ in.) maximum aggregate size.

(1) Place the hot bituminous sample on a suitable, dry surface where there will be neither loss of material nor accidental addition of foreign material. The surface may be covered with either a canvas blanket, heavy paper or other suitable material. Mix the material thoroughly by turning the entire sample over three times. Alternately lift each corner of the blanket or paper and pull it over the sample diagonally toward the opposite corner causing the material to be rolled. With the last turning, lift both opposing corners to form a conical pile carefully flatten the pile to uniform thickness and diameter.

(2) If required, quarter the material using a straightedge metal plate or suitable quartering devise.

(3) If required, use two opposing quarters fill AC content pan and obtain a minimum 500 gm moisture sample return any additional material from these two quarters to the sample container.

(4) Grasp the blanket or paper, roll the remaining two quarters into a loaf and flatten the top.

(6) Pull the blanket or paper so at least ¼ of the loaf is off the edge of the counter, allow it to drop into a pan or box to save, or use to top off the AC content pan if needed.

(6a) Slice off at least ¼ of the loaf and placed into a pan or box. Save this portion for a backup.

(7) Pull additional loaf off the table and drop appropriate size sample into container. Continue this process for the remaining sample(s).

(7a) Slice off the appropriate size sample and place into a container. Continue this process for the remaining samples.

(8) Box the remaining material for additional testing if required.

Note: For ACP Class E and other mixes exceeding 25 mm (1 in.) maximum size. Obtain the specimens for quickwash gradation, "Rice Density" and other tests by scoop sampling of the opposite quarter to source for the AC gauge sample.

7:P:DP/MM

WSDOT Test Method No. 713

Method of Test for Moisture in Bituminous Paving Mixtures

1. SCOPE

   a. This is intended as a quick method for the determination of moisture content.

2. APPARATUS

   a. Balance — Capable of weighing a minimum sample mass (weight) of 1000 g and accurate to 0.1 g.

   b. Drying Apparatus — Capable of maintaining 149°±14°C (300° ± 25°F).

   c. Sample Containers — Any suitable glass or metal container capable of holding a minimum of 1000 g of material.

      Note: The sample container shall be preheated to 149° ± 14°C (300° ± 25°F) prior to taring and filling.

   d. Thermometer — Any accurate thermometer capable of measuring temperature in the indicated range (approximately 149° ± 14°C (300° ± 25°F)).

3. PROCEDURE

   a. Obtain a representative portion of the material to be tested. The size of the sample shall be a minimum of 500 g.

   b. Determine the mass (weight) of the test sample and record this weight as the "initial mass (weight)."

   c. Dry to constant mass (weight) at 149° ± 14°C (300° ± 25°F) for a minimum of two hours.

      Constant mass (weight) has been achieved when additional exposure to the drying process does not cause any noticeable additional mass (weight) loss or the loss in mass (weight) is less than 0.1 percent of the test sample weight. Subsequent drying periods to verify constant mass (weight) shall be of at least ½-hour duration.

   d. Determine the dry mass (weight) of the test sample and record this weight as the "dry mass (weight)."

   e. Calculate the percent of moisture as shown below:

Water Content Calculation for Asphalt Concrete

(*1) Initial mass (weight) (measured hot taken from discharge at the plant) = _____

(*2) Dry mass (weight) (dried to constant mass (weight) using 149° ± 14°C temperature) = _____

(3) Amount of H_2O = #1 – #2 = _____

(4) Percent $H_2O = \frac{\#3}{\#1} \times 100$ = _____

*No. 1 and No. 2 should be weighed at approximately the same temperature.

4. PRECAUTIONS

a. The drying rate of test samples will be affected by the moisture conditions and number of samples in the drying device. Placing wet samples in the drying device with nearly dry samples may retard the drying process.

8:P:DP/MM

WSDOT Test Method No. 715

Method of Test for Relative Compaction of Asphalt Concrete Pavement

1. GENERAL SCOPE

   a. This test method provides a procedure for determining the inplace density of compacted asphalt concrete pavements. Asphalt concrete density measurements are made using a "thin lift" nuclear moisture-density gauge in the backscatter mode of transmission, or with a gauge in the direct transmission mode if the material has adequate depth.

   b. A density measurement shall be the average of two density readings taken in the same location at 90 degrees from each other. The readings shall agree within ± 50 kg/m^3 (± 3 lbs./ft.^{3}) to be valid.

   c. On the basis of specified acceptance criteria, the compaction values are used to determine compliance or noncompliance of compaction specifications within a designated area.

2. EQUIPMENT

   a. Nuclear gauge and standardizing block (reference standard).

   b. Guide plate, drill rod, and hammer.

   c. Cans of spray paint or crayons for marking test sites.

   d. Required report forms.

3. GAUGE CALIBRATION

   a. It is recommended that the machine be turned on when leaving the office so the required warm-up time can take place during the travel to the job site. Always carry the machine secured in the carrying case designed for it. The standard count for the day should be taken at the job site in order that the background levels of radiation and other variables will be the same as when testing.

      Note: Descriptions and procedures are referenced to the most common model of nuclear gauge in use: Troxler Model 3430. Other types of gauges utilize similar measuring procedures but may have controls designated and operated in a different manner.

   b. Remove the standard block from the transport container and place it on a flat high-density surface, i.e., compacted soil, concrete or asphalt surface in an area at least 5 m (15 LF) from any vertical structure and 20 m (66 LF) or more from another nuclear gauge.

   c. Remove the instrument and place it on the standard block with the calculator end of the gauge facing the metal plate on the standard block. The instrument must be firmly seated within the raised edges and pushed against the metal plate. Remove the lock from the trigger and check the POWER switch to be sure it is in the ON position.

   d. The position used for transport is the safe or shielded position and is **also used** to obtain the standard counts, i.e., MS (Moisture Standard) and DS (Density Standard).

   e. The DENSITY STANDARD COUNT which is to be recorded in the Log Book, must be within 1 percent of the average of the previous four DENSITY STANDARD COUNTS recorded in the Log Book.

      The MOISTURE STANDARD COUNT which is to be recorded in the Log Book, must be within 2 percent of the average of the previous four MOISTURE STANDARD COUNTS recorded in the Log Book.

Since all calibration and measurements are made as ratios to the reference standard, these changes will not affect the calibration. A log will be kept on the gauges with a record of the standard counts. Any sudden change in either of the numbers may indicate a defect in the instrument.

f. Locate the test site as described in WSDOT Test Method No. 716.

4. PROCEDURE FOR DIRECT TRANSMISSION MODE

a. Prepare the test site as follows:

(1) Place the scraper plate in the middle of the test site, place one foot on the plate to hold it in position, and drive the drill rod into the mat using a 1.3 to 1.8 kg (3 to 4 lb.) hammer. The rod is to be driven into the mat at least 6.35 mm (¼ in.) further than the testing depth. The testing depth is in increments of 50 mm (2 in.), therefore, the minimum depth of the drill hole is 57 mm (2¼ in.). Use safety glasses while driving the drill rod.

(2) In most cases the drill rod can be withdrawn simply by pulling upward on the rod cap. If difficulty is encountered, the scraper can be used to lightly tap and pull the rod from the mat. Care should be used to prevent enlarging the hole.

b. Set up gauge on test site as follows:

(1) Place the instrument over the prepared test site so that the source rod lines up with the hole. Depress the trigger and push the handle down to the properly indexed position at the desired test depth. Be certain that the trigger is indexed into the slot in the index rod. Pull the gauge toward the calculator end so as to seat the source rod against the side of the hole.

(2) Start the test and note the wet density after a one minute time period.

(3) The number shown is the wet density in kg/m^3 ($lb./ft.^3$). If correlation cores are to be taken, outline the position of the gauge with spray paint and mark the test number with spray paint.

(4) Rotate the gauge 90 degrees and repeat the process steps b.(2) and b.(3). Check the validity of the results, the two readings are to be within $\pm$ 50 kg/m^3 ($\pm$ 3 $lb./ft.^3$) in order to be considered to be acceptable.

(5) Retract the source rod and remove the gauge from the test site.

5. NUMBER AND LOCATIONS OF NUCLEAR TESTS

a. The area concept in the testing of control lots will be used with this test.

b. Control lots.

Control lots representing 400 metric tonnes (400 tons) or less of mix shall be established. Nuclear gauge tests for compaction control during paving construction shall be taken at a minimum of five locations per control lot. The locations will be picked at random by the Engineer using WSDOT Test Method No. 716.

6. ACCEPTANCE

a. For acceptable compaction, nuclear gauge test results for the control shall be as required by current specifications or contract plans.

b. Whenever the density so determined is greater than 98 percent of Rice density for wearing course, a change in mix design will be required.

7. CORRELATION OF NUCLEAR GAUGE DETERMINED DENSITIES WITH ASPHALT CONCRETE PAVEMENT CORES

a. Density determination for density acceptance on asphalt concrete pavement shall be made in the direct transmission mode whenever possible.

b. Gauge-core correlation shall be required for statistical evaluation of degree of asphalt compaction.

(1) For each combination of gauge and job mix formula.

(2) For direct transmission and for back scatter modes (when used).

(3) For a change in direct transmission probe depth.

c. A new gauge-core correlation is not required.

(1) For different contracts if JMF and gauge are the same.

(2) For a change in bases (i.e., surfacing to overlay).

d. Gauge correlation is based on 10 density determinations and 10 cores taken at corresponding locations. Gauge densities shall be determined on the day of paving. Cores shall be taken no later than the day following paving.

e. Core densities shall be determined in conformance with WSDOT Test Method 704: Method of Test for Specific Gravity and Weight per Cubic Foot of compacted Asphalt Mixtures.

f. Correlation factor shall be determined in accordance with Standard Form 350-112: Correlation Nuclear Gauge to Core Density.

10:P:DP/MM

WSDOT Test Method No. 716

Method of Random Sampling for Locations of Testing and Sampling Sites

1. SCOPE

   a. This method outlines the procedure for selecting sampling and testing sites in accordance with accepted random sampling techniques. It is intended that all testing and sampling locations be selected in an unbiased manner based entirely on chance.

   b. Testing and sampling locations and procedures are as important as testing. For test results or measurements to be meaningful, it is necessary that the sampling locations be selected at random, typically by use of a table of random numbers. Other techniques yielding a system of randomly selected locations are also acceptable.

2. APPLICATIONS TO ASPHALT PAVING DENSITY

   a. This method, although general in nature, is primarily used for, and the examples are based on, locations of tests for asphalt concrete density.

   b. A table of random numbers, adapted for specific use in locating asphalt pavement density test sites, is included for this purpose. In using other procedures care should be taken so that lateral locations are at least 0.45 m (1.5 LF) from the edge of a paving pass. Locations within 8 m (25 LF) of an end joint should also be avoided. Whenever a test location is determined to fall within such an area (i.e., bridge end, track crossing, or night joint) the test location should be moved ahead or back on stationing, as appropriate, by 8 m (25 LF).

   c. To address concerns with equal representation and avoidance of concentrated sampling within a LOT, an optional procedure for stratified random sampling is provided.

   d. A simplified selection process is provided based on standard LOT lengths for typically encountered paving sections.

3. PROCEDURE

   a. Detailed computation based on sampling from random selection of the entire lot.

      (1) Determine the LOT size and number of tests per LOT. The Standard specifications set the size of density test lot for Asphalt Concrete Pavement as 400 tonnes (400 tons) and require five tests per LOT.

      (2) Convert this LOT size to an area segment of the roadway based on the roadway section and depth being constructed for the course being tested.

      LOT length may also be determined based on Nominal Designated LOT sizes. To utilize this concept, compacted mix volumes equivalent to the designated mix quantity per LOT have been determined using the nominal compacted unit weight of asphalt concrete pavement. These volumes are then converted into Density LOT lengths using the typical lane width and specified compacted depth. The included tables present the values for LOT Lengths based on metric and on customary units.

      (3) Determine the locations of the test (or sampling) sites by using values from the random number table (Table 1) to determine the coordinate location on the roadway. In the table, use the “X” values as decimal fractions of the total length of the lot; use the “Y” values as fractions of the width, customarily measured from the right edge of the pavement. The values in the table have been set so that no measurement are taken in within 0.45 m (1.5 LF) of the edge of the pavement.

Y values are selected so that lateral locations are no closer than 0.45m (1.5 foot) from the edge of a paving strip

SEQUENCE	X	Y	SEQUENCE	X	Y	SEQUENCE	X	Y	SEQUENCE	X	Y	SEQUENCE	X	Y
1	0.290	0.33	21	0.712	0.17	41	0.172	0.87	61	0.768	0.32	81	0.477	0.85
2	0.119	0.43	22	0.193	0.17	42	0.430	0.87	62	0.893	0.37	82	0.267	0.44
3	0.694	0.32	23	0.976	0.69	43	0.704	0.19	63	0.504	0.66	83	0.933	0.28
4	0.722	0.47	24	0.997	0.63	44	0.009	0.18	64	0.043	0.31	84	0.974	0.87
5	0.784	0.39	25	0.930	0.44	45	0.552	0.17	65	0.284	0.39	85	0.600	0.46
6	0.953	0.15	26	0.657	0.69	46	0.626	0.29	66	0.196	0.15	86	0.591	0.19
7	0.576	0.14	27	0.761	0.27	47	0.144	0.62	67	0.742	0.66	87	0.165	0.77
8	0.069	0.74	28	0.389	0.69	48	0.246	0.13	68	0.941	0.43	88	0.668	0.41
9	0.691	0.86	29	0.751	0.20	49	0.055	0.40	69	0.531	0.31	89	0.327	0.29
10	0.973	0.44	30	0.191	0.77	50	0.678	0.66	70	0.478	0.56	90	0.473	0.51
11	0.328	0.50	31	0.006	0.50	51	0.762	0.65	71	0.228	0.37	91	0.598	0.58
12	0.468	0.78	32	0.456	0.23	52	0.285	0.28	72	0.008	0.48	92	0.373	0.69
13	0.183	0.44	33	0.367	0.85	53	0.347	0.87	73	0.002	0.17	93	0.244	0.24
14	0.669	0.36	34	0.025	0.73	54	0.962	0.75	74	0.330	0.42	94	0.831	0.14
15	0.971	0.71	35	0.299	0.33	55	0.203	0.60	75	0.089	0.20	95	0.178	0.45
16	0.336	0.37	36	0.194	0.25	56	0.803	0.35	76	0.434	0.43	96	0.821	0.46
17	0.314	0.78	37	0.936	0.37	57	0.672	0.17	77	0.832	0.71	97	0.124	0.62
18	0.508	0.44	38	0.231	0.71	58	0.306	0.20	78	0.044	0.73	98	0.580	0.57
19	0.347	0.20	39	0.050	0.74	59	0.223	0.83	79	0.235	0.28	99	0.037	0.24
20	0.877	0.85	40	0.584	0.43	60	0.166	0.58	80	0.271	0.62	100	0.700	0.59

Table 1: Random Numbers for Test Locations

In order to determine which “X” and “Y” values should be used, enter the table on a line chosen by chance. Recommended procedures are selection of a line based on the terminal digits of a passing car license plate or use of the last two digits from the most recent standard count on the Nuclear density gage. Subsequent “X” and “Y” values are then taken from the lines which follow. Based on the specified sampling frequency, 20 lots can be accommodated by one cycle through the table. Start each shift with a set of values determined by chance in order to obtain random selection.

b. Stratified Random Sampling

(1) Following determination of the LOT length in Procedure A, above, determine the length increment for individual sublots by dividing by the number of such desired sublots. In the case of Asphalt Concrete Pavement this would be five sublots

(2) Determine random location factors “X” and “Y” values by random entry to the table as described in procedure a.

(3) From the known beginning station determine the location of test No. 1 in sublot No. 1 by multiplying the sublot increment length by the selected “X” factor from the Random Number table. This distance is used to add or subtract from the beginning station depending on the direction of progress. Test locations within each of the subsequent sublots are determined by adding (or subtracting) the unit lengths of the preceding sublot increments and then determining the fractional location within the sublot interval. A computation and test record form (DOT Form 350-092, see Figure 1) has been provided to eliminate the use of separate test location and density record forms.

(4) For irregular lengths at the end of a paving strip (or “pull”) determine the length, divide into 5 equal increments and define a test location within each.

Table 2: Asphalt Concrete Density Test Lot Sizes Metric Units

400 tonne lot at 2 439 kg/m3 = 164 m3

Lane Width	Compacted Depth	Computed Lot Length	Recommended Lot Length
3.6 meters	40 mm	1139	1140
	45 mm	1012	1010
	60 mm	759	760
	75 mm	607	610
3.3 meters	40 mm	1242	1240
	45 mm	1104	1100
	60 mm	828	830
	75 mm	663	660

Washington State Department of Transportation

Asphalt Concrete Pavement Compaction Report

Date	Region	Project Engineer	SR Number	Section	Contract Number

Class ☐ ☐ ☐ ☐ / ☐ ☐ ☐ ☐	☐ ☐ ☐	Air Temperatures Start End	Gauge Serial Number	Rice Density	Correlation Factor	Plan Depth (D)

Beginning Station	Lot Length (A)	Sublot Length [(A) x 0.2] = (L)	Width (W)	Station To Station	Lane ☐ ☐ ☐ ☐ / ☐ ☐ ☐	Lot # / Tons	ACP Test Temp.

		Random Length (X) x (L)										
1			Zero									
2			(L)									
3			(L) x 2									
4			(L) x 3									
5			(L) x 4									

Beginning Station	Lot Length (A)	Sublot Length [(A) x 0.2] = (L)	Width (W)	Station To Station	Lane ☐ ☐ ☐ ☐ / ☐ ☐ ☐	Lot # / Tons	ACP Test Temp.

		Random Length (X) x (L)										
1			Zero									
2			(L)									
3			(L) x 2									
4			(L) x 3									
5			(L) x 4									

Remarks

Rollers			
Passes			

Roller Codes:
SDV - Single Drum Vibrator
DDV - Double Drum Vibrator
P - Pneumatic

Figure 1

English Units
400 Ton lot at 152 lbs./ft.^{3} = 5263 ft3

Lane Width	Compacted Depth	Computed Lot Length	Recommended Lot Length
12 feet	0.12″	3655	3700
	0.15	2924	2900
	0.20	2193	2200
	0.25	1754	1800
11 feet	0.12	3987	4000
	0.15	3189	3200
	0.20	2392	2400
	0.25	1913	1900

Sample Computations (Metric Units)

Using nominal compacted density of 2 439 kg/m^3, compacted depth of 40 mm and paving width of 3.6 m:

Lot Length:

400 tonnes equate to 400 000 kg

Crossection pavement area: 3.6 m wide, 0.040 m (40 mm) deep = 0.144 m^2

Unit weight per meter length = 0.144 m^2 × 2439 kg/m^3 = 351.2 kg/m

Length = 400 000 kg/351.2 kg/m = 1138.9 m round to 1140 m

Sublot length = 1140 m × 0.2 = 228 m

These typical figures may be revised based on the actual densities achieved or the yield results from the paving involved.

Test Location Within the LOT

For the lot defined above (3.6 m wide, 1139 m long) starting at station 10 000.00 m

Using the license plate method and an assumed first plate: GUT 351. Determine the “X” and “Y” values from line (51) in the table: X = 0.762, Y = 0.65 (These are illustrative examples only. Table format and generation have been randomized so that each replication of the table will vary.)

Beginning station: 10 000.00

Sublot length increment: 1140 × 0.762 = 173.7 m

Width offset: 3.6 × 0.65 = 2.3 m (from right edge)

Location is station: 10 000 + 173.7 = 10 173.7, 2.2 m from right edge

Sample Computation (English Units)

Using nominal compacted density of 137 #/sy/.10 LF compacted (equivalent to a density of 152 pcf), compacted depth of 0.15 ft., and a paving width of 12 ft.:

Lot Length:

400 tons (normal density lot)

Density Factor

137#/sy @ .10′ deep = 206 #/sy @ .15′ deep or 0.103 T/sy, .15′ deep

$$\text{Area of lot} = \frac{\text{Tons per Lot} \times 9}{.103\ \text{T/sy}} = \frac{400\ \text{T} \times 9\ \text{sf/sy}}{.103\ \text{T/sy}} = 34{,}951.5\ \text{LF}$$

$$\text{Control lot length } \frac{\text{Area of Control Lot}}{\text{Lane Width}} = \frac{34{,}951.5\ \text{sf}}{12\ \text{LF}} = 2{,}912.6\ \text{LF}$$

Round to nearest 50 LF, i.e., 2,912.6 LF = 2,913 LF

Sublot length = 2400 LF × 0.2 = 580 LF

Approximate LOT lengths for other typical paving widths at 0.15 LF depth are:

8 LF	4,350 LF
10 LF	3,500 LF
11 LF	3,200 LF
12 LF	2,900 LF
24 LF	1,450 LF

These typical figures may be revised based on the actual densities achieved or the yield results from the paving involved.

Test Location Within the LOT

For the lot defined above: (12 LF wide, 0.15 LF deep, starting at station 168 + 75 with paving progressing ahead on station), Lot length was previously determined as 2,900 LF Using the license plate and an assumed first plate: GUT 351 as in the example, above, for metric computations, using the assumed “X”and “Y”values from line (51) in the table: X = 0.762, Y = 0.65.

Beginning station: 168 + 75

Sublot length increment: 580 × 0.762 = 442 (round to 1485)

Width offset: 12 × 0.65 = 7.8 LF (from right edge)

Location is: station: 168+75 + 442 = 173 + 17, 7.8 LF from right edge

11:P:DP/MM

WSDOT Test Method No. 722

Method of Test for Determination of Asphalt Content by Nuclear Method

1. SCOPE

   a. This method covers a procedure for the determination of asphalt content of an asphalt concrete mixture using the Troxler Model 3241C Nuclear Asphalt Content Gauge. This test method generally utilizes information obtained from cross calibration and from a job mix calibration by another gauge. These procedures are included as Appendix 2 and Appendix 1.

2. APPARATUS

   a. Troxler Model No. 3241C Nuclear Asphalt Content Gauge.

   b. Metal sample pans supplied with the gauge.

   c. Metal plate, plywood, or other rigid flat object which can be used to flatten the sample level with the top of the sample pan.

   d. Balance (capacity of 11 kg and sensitive to 0.1 g).

   e. Thermometer (capable of measuring to 176°C (350°F).

   f. Miscellaneous Hand Tools — Spatula, scoop, spoon, putty knife.

3. STANDARDIZATION

   a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauge in a place in the test lab where it will not need to be moved and where it will be away from water sources such as storage tanks, wet scrubbers, wash racks, etc., and other nuclear devices. Keep the top of the chamber free of all materials.

   b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates “ready.”

   c. Set printer to “on” (press **SHIFT**, **AUTO**).

   d. Set the time to “16 minutes” (press **TIME**).

   e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Be sure to use the new background count for your testing. Record the background count in the book provided with the nuclear asphalt content gauge. A background count should be taken prior to the first test run each day. If the results vary by more than 1 percent from the previous recording, a new background count should be taken and background counts should be taken more frequently.

      If conditions around the gauge change during the day, additional background counts should be taken and recorded.

   f. The cross calibration(s) and the job mix calibration need to be stored in the gauge. A step by step data input procedure is attached. The readout on the console also leads the operator through this procedure.

      Note: Cross calibration may already be in the gauge.

      Note that the ***field*** gauge is the gauge that is being used for the testing, and the ***master*** gauge is the gauge that was used for the nuclear asphalt content calibration.

Note the ***master gauge transfer number***. It is critical this number series and concept be maintained when using the cross-calibration concept. The order is the last three digits of the master gauge serial number, a dot (.), then the last three digits of the field gauge serial number. Example: 106.302.

g. Assurance or independent assurance samples of asphalt concrete sent to the region or the FOSSC Materials Lab need to be identified by the calibration number. This ensures that all can recognize which mix design and calibration is being used for acceptance.

4. PROCEDURE

a. Select the proper calibration number that has been stored in the gauge.

b. Set the test time to 8 minutes.

c. Obtain a sample of asphalt concrete mix using WSDOT Test Method 712. Generally, three (3) test specimens will be obtained using this procedure outlined. One sample is for the nuclear asphalt content gauge, approximately 8000 g. The second sample is for a moisture content and is taken and tested at the same time as the nuclear asphalt content, approximately 500 g. The third sample is the quick wash for aggregate gradation, approximately 1000 g.

d. Heat the sample pan to the 135° ± 14°C (275° ± 25°F) or to the mix temperature prior to filling.

e. Fill the nuclear gauge sample pan with hot mix to approximately one-half the height of the pan and level it out with a suitable tool such as a putty knife. Do not compact this material. Continue adding material to the sample pan until the weight of the mix in the pan is within ± 5 g of the blank mass (weight) as established during the nuclear asphalt content calibration for this job.

f. Immediately after filling the sample pan, place the metal, plywood, or other rigid flat object on the mix and sample pan and compact the sample into the pan by standing or kneeling on the flat object until it is level with the rim of the pan.

g. Recheck the mass (weight) of the mix in the pan to ensure that it is within ± 5 g of the blank mass (weight).

h. Place the sample pan containing the asphalt mix in the asphalt content gauge. Press **START** and follow the direction on the console for the nuclear asphalt content gauge to determine the percent of asphalt cement. Reverse the sample pan and determine a second reading. Average the two readings and record the information. When quick washes are to be done, this information should be recorded on DOT Form 350-100A (Quick Wash with Nuclear Asphalt). If the difference between the two readings is greater than 0.4 percent, refill the pan and start again.

i. The moisture content of this material, run in accordance with WSDOT Test Method 713, needs to be determined at the same time and from a split of the same material used for nuclear asphalt content. Record the moisture content in the appropriate areas. If using the quick wash procedure with nuclear asphalt, record the information on DOT Form 350-100A.

Note: If the filled nuclear asphalt content pan has been allowed to cool to room temperature, it shall be reheated to 135° ± 14°C (275° ± 25°F) or to the mix design temperature prior to testing. A new moisture content sample shall be taken from the sample pan immediately after the asphalt percent determination has been made.

5. CALCULATIONS

a. The asphalt content obtained from the nuclear asphalt content gauge is corrected for moisture by subtracting moisture percent obtained from the moisture content obtained in WSDOT Test Method 713. Record the percent corrected asphalt on the Quick Wash with Nuclear Asphalt form (DOT Form 350-100A), if the quick wash procedure is being used.

CROSS-CALIBRATION DATA INPUT PROCEDURE (IF REQUIRED)

1. [SHIFT] [SPECIAL], [YES], [5] - Calib. Trans.
2. [1] - Cross Calib.
3. How many samples (5-12)? Input __6__ and Press [ENTER]
4. Field Gauge Measurement, [1] - Keypad input
5. Field Gauge Background: _____ [ENTER]
6. Field Gauge Sample #1 count: ____ [ENTER]
7. Field Gauge Sample #2 count: _____ [ENTER]
8. Field Gauge Sample #3 count: _____ [ENTER]
9. Field Gauge Sample #4 count: _____ [ENTER]
10. Field Gauge Sample #5 count: ____ [ENTER]
11. Field Gauge Sample #6 count: _____ [ENTER]
12. Master Gauge Background: _____ [ENTER]
13. Field Gauge Sample #1 count: _____ [ENTER]
14. Field Gauge Sample #2 count: ____ [ENTER]
15. Field Gauge Sample #3 count: _____ [ENTER]
16. Field Gauge Sample #4 count: _____ [ENTER]
17. Field Gauge Sample #5 count: _____ [ENTER]
18. Field Gauge Sample #6 count: ____ [ENTER]
19. Review Data:

    [1] - Printout
20. Master Gauge Transfer Number: _____._____

    Note: __A__.__B__C__

    A = last 3 digits of master gauge serial number (.)

    B = last 3 digits of the field gauge serial number

    C = blank
21. Cross Calib. completed and stored! Press [ENTER]

CALIBRATION TRANSFER DATA INPUT PROCEDURE

1. [SHIFT] [SPECIAL], [YES], [5] - Calib. Trans.
2. [2] - Transfer
3. [2] - Next Trans # (scroll to required transfer number)
4. [1] - Select
5. A1: _____
   Select: 1 = +
   2 = -
6. Input A1 and press [ENTER]
7. A2: _____
   Select: 1 = +
   2 = -
8. Input A2 and press [ENTER]
9. A3: _____
   Select: 1 = +
   2 = -
10. Input A3 and press [ENTER]
11. Input the design calibration Background Count _____ [ENTER}
12. Input the Blank Mass (weight) _____ g. [ENTER]
13. Calibration Activated! Want to store Calibration? [YES]
14. Input the Calibration # _____ from the design and press [ENTER]
15. Input the Mix ID # _____ from the design and press [ENTER]

15:P:DP/MM

WSDOT Test Method No. 722, Appendix 1

Method of Test for Calibration of the Troxler 3241C Nuclear Asphalt Content Gauge for Job Mix

1. SCOPE

    a. This method covers a procedure for a four-pan calibration of the Troxler 3241C Asphalt Content Gauge for a particular job aggregate and asphalt.

2. APPARATUS

    a. Troxler Model No. 3241C Nuclear Asphalt Content Gauge.

    b. Four metal sample pans for the nuclear asphalt content gauge.

    c. Metal plate, plywood, or other rigid flat object which can be used to flatten the sample level with the top of the sample pan.

    d. Balance (capable of 16 kg (35.28 lbs.) and sensitive to 0.1 g).

    e. Thermometer (capable of measuring to 176°C (350°F).

    f. Miscellaneous Hand Tools — Spatula, scoop, spoon, putty knife, straightedge.

    g. Mixer — Mixing can be by hand but a mixer similar to the Hobart A200 is preferred.

    h. Bowls and mixing paddle compatible with the mixer that will adequately mix approximately 8000 g of asphalt concrete. Bowls and spoons if mixed by hand.

        Note: The mixing bowl and paddle needs to be heated to the mixing temperature and buttered with asphalt and aggregate prior to mixing.

    i. Oven(s) for heating the bowls and material to 135°C (275°F).

3. STANDARDIZATION

    a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauge in a place in the test lab where it will not need to be moved and where it will be away from water storage tanks and at least 9 m (30 LF) from other nuclear devices. Keep the top of the chamber free of all materials.

    b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates “ready.”

    c. Set printer to “on” (press **SHIFT**, **AUTO**).

    d. Set the time to “16 minutes” (press **TIME**).

    e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Record the background count in the book provided with the nuclear asphalt content gauge. If the results vary by more than 1 percent from the previous recording, a new background count should be taken and background counts should be taken more frequently.

        If conditions around the gauge change during the calibration, the testing should be stopped, and a new background count taken and the testing started over.

4. PROCEDURE

a. Obtain samples of asphalt and aggregate to be incorporated into the work. Changes in aggregate or asphalt sources will necessitate a new job mix calibration.

b. Thoroughly dry the aggregate materials and proportion them together according to the job mix proposal. The more accurately these materials are proportioned together, the closer the calibration will be to the production mix; therefore, the more accurate the results.

c. Weigh 7500 g ± 5 g of dried aggregate into each of four pans, of the job mix gradation. Heat the aggregate and the asphalt cement to 135° ± 5°C (275° ± 10°F).

The 135°C (275°F) temperature is intended to approximate the mix that will be tested at the contractor's site. If there are going to be significant variations from this at the site, this temperature needs to be corrected.

d. Place heated mixing bowl on balance and add one dry, hot aggregate sample and add hot asphalt at the job mix formula content + 0.4 percent, (pan No. 3) by mass (weight) of total sample.

$$\text{mass (weight) asphalt} = \frac{(\text{dry wt (mass) of agg})\ (\text{JMF \% } + \text{ 0.4\%})}{100 - (\text{JMF \% } + \text{ 0.4\%})}$$

e. Mix this material thoroughly. The mechanical mixers should take approximately three minutes. If the material cools during mixing without thorough coating, reheat and continue mixing.

f. Place all of the material from the mixing bowl on a piece of heavy paper or canvas and split out the required amount of the material to fill the sample pan.

g. Fill a heated nuclear sample pan approximately one-half full with mix at 135° ± 5°C (275° ± 10°F) and level it out with a putty knife or suitable tool. Do not compact.

h. Continue adding material to pan No. 3, adding enough material so that the mix is approximately 12.5 mm (½ in.) above the top of the pan. For the additional pans, add the material until the mass (weight) in the pan is within ± 5 g of the blank mass (weight).

i. Immediately after filling the sample pan, place the metal plate or other flat object on the sample pan and compact the sample into the pan until it is level with the rim of the pan by standing or kneeling on the plate.

j. Weigh and record the mass (weight) of the mix in pan No. 3 as the blank mass (weight) on the job mix calibration work sheet. It is important that all future samples use this mass (weight).

Note: If an additional Nuclear Calibration is done for a Job Mix Design, the blank mass (weight) shall be the same as the original Job Mix Calibration unless problems arise with over filling or under filling the pan. If this occurs, a new blank mass (weight) will be determined.

k. Recheck the mass (weight) of the mix in the pan to ensure that it is within ± 5 g of the blank mass (weight).

l. Place the pan containing the asphalt mix in a 135°C (275°F) oven.

m. Prepare the first, second, and fourth sample pans at the job mix formula content – 1.2 percent, -0.4 percent, and +1.2 percent. Follow steps d. through l. except ***do not*** adjust the blank mass (weight).

n. Set the gauge to 16 minutes.

o. Start the nuclear asphalt content gauge by pressing **CALIB** and follow the directions on the console for running a new calibration.

p. Remove the samples one at a time from the 135°C (275°F) oven and immediately place the sample pans in the nuclear asphalt gauge. Record the results of each on the calibration work sheet.

5. CALCULATIONS

a. After all samples have been measured, record the A1, A2, A3, the coefficient of fit, and the calculated percent difference for each pan. If either the fit coefficient is less than 0.995, and/or any single pan has a calculated percent difference greater than 0.09 percent, the calibration is not acceptable and will have to be redone.

b. Review the calibration data and prepare a report.

c. Distribute a copy of the Job Mix Calibration to each of the labs using the calibration: Olympia Service Center, Region, and Field.

16:P:DP/MM

WSDOT Test Method No. 722, Appendix 2

Method of Test for Cross Calibration of Nuclear Asphalt Content Gauge

1. SCOPE

    a. This method covers a procedure for the cross calibration of Troxler Model 3241C Nuclear Asphalt Content Gauges. The procedure utilizes six standard pans (sealed pans of known asphalt content) stored at the Headquarters Bituminous Laboratory. The cross calibration of gauges allows a job mix calibration performed on one gauge to be transferred to other gauges. This procedure will be generally done by headquarters lab personnel.

2. APPARATUS

    a. Troxler Model No. 3241C Nuclear Asphalt Content Gauges.

    b. Six sealed standard pans with known asphalt content kept in the FOSSC Materials Laboratory.

3. STANDARDIZATION

    a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauges in a place in the test lab where it will not need to be moved and where it will be away from water storage tanks and at least 9 (30 LF) m from other nuclear devices. Keep the top of the chamber free of all materials.

    b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates “ready.”

    c. Set printer to “on” (press **SHIFT**, **AUTO**).

    d. Set the time to “16 minutes” (press **TIME**).

    e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Record the background count in the book provided with the nuclear asphalt content gauge. If the results vary by more than one percent (1 percent) from the previous recording, a new background count should be taken.

    If conditions around the gauge change during the calibration, the testing should be stopped, and a new background count taken and the testing started over.

4. PROCEDURE

    a. Press “Calibration/New Calibration/Gauge Derived” on the console. Follow the directions on the console of the gauge.

    b. Enter the blank mass (weight) of the pans. (The predetermined mass (weight) of all the material in the pan.)

    c. Enter the number of pans which are six (6).

    d. Enter the percent asphalt for pan No. 1 which is 1.5 percent.

    e. Load Sample No. 1 into testing chamber and run a 16-minute count. Record the count on the form for cross-calibration.

    f. Repeat steps d. and e. for the remaining five pans at 3.0 percent, 4.5 percent, 6.0 percent, 7.5 percent, and 9.0 percent asphalt.

5. CALCULATIONS

a. After all samples have been measured, record the A1, A2, A3, the coefficient of fit, and the calculated percent difference for each pan. If either the fit coefficient is less than 0.995, and or any single pan has a calculated percent difference greater than 0.09 percent, the calibration is not acceptable and will have to be redone.

b. Record all values on the cross calibration form and record in the front of the field book supplied with the gauge.

17:P:DP/MM

WSDOT Test Method No. 723

Method of Test for Quick Determination of Aggregate Gradation Using Alternate Solvent

1. SCOPE

   a. This method covers a procedure for the determination of aggregate gradation of paving mixtures and pavement samples.

   b. Summary of Method

      Solvent and agitation are used to wash the asphalt from the mixture and the liquid is decanted through a 75 µm (U.S. No. 200) mesh sieve. A sieve analysis of the dried aggregate can be made at this point by using the asphalt content determined by the nuclear asphalt content gauge WSDOT Test Method No. 722.

2. APPARATUS

   a. Balance capable of weighing at least 4000 g to the nearest 0.1 g.

   b. Two or more suitable pans with handles, approximately 3 L size.

   c. 75 µm (U.S. No. 200) mesh sieve for washing.

   d. 25.4 + cm (10 + in.) diameter funnel cut-off to small end diameter of 12.7 to 15.24 cm (5 to 6 in.), optional for use to prevent spillage.

   e. Sieves — Complete set, 20.32 cm (8 in.) diameter or larger, specification sizes.

   f. Drying Apparatus — Capable of maintaining 135° ± 14°C (275° ± 25°F).

   g. Flat Drying Pans — Approximately 27.94 cm × 40.64 cm (11 in. × 16 in.).

   h. Wash bottles.

   i. Spoons, brushes, spatulas for sample agitation.

3. REAGENTS AND SUPPLIES

   a. Biodegradable, water soluble, organic solvent with a minimum flash point of 60°C (140°F), as approved by FOSSC Materials Lab.

      Precautions: Solvents used for this test procedure are toxic to some degree. Inhaling them or constant skin contact can be dangerous. The manufacturer's MSDS sheets for the product being used needs to be available for quick reference. The operator should wear protective equipment and work in a well ventilated area. Specific protective measures may be prescribed by the manufacturer's MSDS or departmental safety directives.

4. PREPARATION OF SAMPLE

   a. Split the sample per WSDOT Test Method 712 to approximately 1000 g (1500 g for Class E). Place in a suitable container and determine the sample weight while the temperature of the mix is hot. Record on DOT Form 350-100A, Quick Wash With Nuclear Asphalt.

      Note: When cores are used for the sample, they shall be heated and the outside cut edges and the underlying surface removed prior to determining the sample mass (weight).

5. WASHING THE SAMPLE

   a. Add approximately 300 ml of solvent to the warm mix.

   b. Agitate the mix and solvent thoroughly by stirring motion. Let the sample soak for 8 ± 3 minutes.

   c. Decant the liquid through a 75 µm (U.S. No. 200) sieve into a settling pan.

   d. Add approximately 200 ml of solvent or enough to substantially cover the mixture.

   e. Agitate by stirring and again decant the liquid through the 75 µm (U.S. No. 200) sieve.

   f. Repeat the wash process several times using approximately 150 ml of solvent with each wash until the decanted solvent appears straw colored. The final wash can be made with approximately 200 ml of solvent. As much as 3,000 ml of solvent may be required to complete washing.

   g. Wash the particles caught on the 75 µm (U.S. No. 200) sieve with solvent.

   h. Wash the clean aggregate with approximately 500 ml of water in a manner similar to the solvent washing process and decant the liquid through the 75 µm (U.S. No. 200) sieve. The water soluble solvent will wash off the aggregate as a milky colored liquid. Repeat the water washing several times until the decanted liquid appears reasonably clear.

   i. Wash the aggregate retained on the 75 µm (U.S. No. 200) sieve with water.

   j. Transfer the clean aggregate from the wash pan and the 75 µm (U.S. No. 200) sieve to a flat drying pan. Dry to a constant weight 135° ± 14°C (275° ± 25°F).

   k. Allow the aggregate to cool; then make a sieve analysis. Record the weights on DOT Form 350-100A. Note that insufficient washing will leave traces of asphalt on the aggregate.

6. CALCULATION

   The total aggregate in the sample is derived by subtracting the corrected nuclear asphalt content weight from the original dry sample mass (weight).

18:P:DP/MM

WSDOT Test Method No. 725

Method of Test for Field Verification of a Job Mix Calibration for the Nuclear Asphalt Content Gauge

1. SCOPE

   a. This procedure verifies a job mix calibration using the Troxler Model 3241C Nuclear Asphalt Content Gauge for a particular job aggregate and asphalt.

   b. The verification testing is performed using the same nuclear gauge, and at or near the same location that the acceptance testing will be done.

2. APPARATUS

   a. Troxler Model No. 3241C Nuclear Asphalt Content Gauge.

   b. Metal sample pans supplied with the gauge.

   c. Metal plate, plywood, or other rigid flat object which can be used to flatten the sample level with the top of the sample pan.

   d. Balance (capacity of 11 kg and sensitive to 0.1 g).

   e. Thermometer (capable of measuring to 176°C (350°F)).

   f. Miscellaneous Hand Tools — Spatula, scoop, spoon, putty knife, straightedge.

   g. Bowls and mixing spoons that will adequately mix approximately 8000 g of asphalt concrete.

      Note: The mixing bowl and spoon need to be buttered with the asphalt and aggregate that you intend to use prior to mixing.

   h. Oven(s) for heating the bowl and material to 135°C (275°F).

3. STANDARDIZATION

   a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauge in a place in the test lab where it will not need to be moved and where it will be away from water sources such as storage tanks and other nuclear devices. Keep the top of the chamber free of all materials.

   b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates “ready.”

   c. Set printer to on (press SHIFT, AUTO).

   d. Set the time to 16 minutes (press TIME).

   e. Take a 16-minute background count with nothing in the chamber. Press BKG and follow the directions on the console for running a background count. Record the background count in the book provided with the nuclear asphalt content gauge. A background count should be taken prior to the first test run each day. If the results vary by more than 1 percent from the previous recording, a new background count should be taken.

      If conditions around the gauge change during the day, additional background counts should be taken and recorded in the book.

      Note: Steps a. through e. are the same as WSDOT Test Method 722.

4. MATERIAL

   a. Sample of the asphalt cement shall be taken from the contractor's storage tank. Confirm that the material stored in the tank is the same asphalt that has been approved for use and was used for the design.

   b. Samples of aggregate to be incorporated into the work shall be taken from the cold feed belt, or have the contractor hot batch a sample of the aggregate. As a last alternative, sample from the stock piles, and proportion them together according to the job mix calibration.

   c. Place the aggregate into the oven and thoroughly dry to a constant weight at 135° ± 5°C (275° ± 10°F).

5. PROCEDURE

   a. Weigh 7500 ± 5 g of dried aggregate into a pan, heat it and the asphalt cement to 135° ± 5°C (275° ± 10°F), or the recommended mixing temperature per the mix design.

   b. Place heated mixing bowl on balance and add the dry, hot aggregate sample, and add hot asphalt at the job mix formula content by mass (weight) of total sample.

$$\text{weight asphalt} = \frac{(\text{Dry wt of agg})\ (\text{JMF\%})}{(100\ -\ \text{JMF\%})}$$

   Example:

$$\text{weight asphalt} = \frac{(7500)\ (5.4\%)}{100\ -\ 5.4\%)}$$

   c. Mix this material thoroughly. If the material cools during mixing without thorough coating, reheat and continue mixing.

   d. Place all of the material from the mixing bowl on a piece of heavy paper or canvas and split out the required amount.

   e. Fill a heated nuclear sample pan with mix at 135° ± 5°C (275° ± 10°F) to approximately one-half the height of the pan and level it out with a putty knife or suitable tool. Do not compact.

   f. Continue adding material to the pan until the mass (weight) of material in the pan is within ±5 g of the blank mass (weight).

   g. Immediately after filling the sample pan, place the metal, plywood, or other rigid, flat object on the sample pan and compact the sample of the mix into the pan by standing or kneeling on the flat object until it is level with the rim of the pan.

   h. Recheck the mass (weight) of the mix in the pan to ensure that it is within ±5 g of the blank weight.

   i. Select the proper calibration for the calibration that you are comparing and ensure that it is in the gauge correctly.

   j. Set the gauge to 8 minutes.

k. Place the sample pan containing the asphalt mix in the AC gauge. Press START, follow the direction on the console of the nuclear asphalt content gauge to determine the percent of asphalt cement. Reverse the sample pan and determine a second reading. Average the two readings. If the difference between the two readings is greater than 0.4 percent, empty the sample and refill the pan and start over again.

6. CALCULATIONS

a. Compare the corrected gauge asphalt content with the asphalt content that the sample was mixed at. If the difference between the two asphalt contents is greater than 0.3 percent, then a new job mix calibration has to be done by either FOSSC Materials Lab or by the Region Lab.

b. Report the results of the test on the calibration form and distribute copies to: Olympia Service Center Construction, Olympia Service Center Bituminous Section, Region Lab, and the Project Engineer.

20:P:DP/MM

WSDOT Test Method No. 802

Method of Test for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)

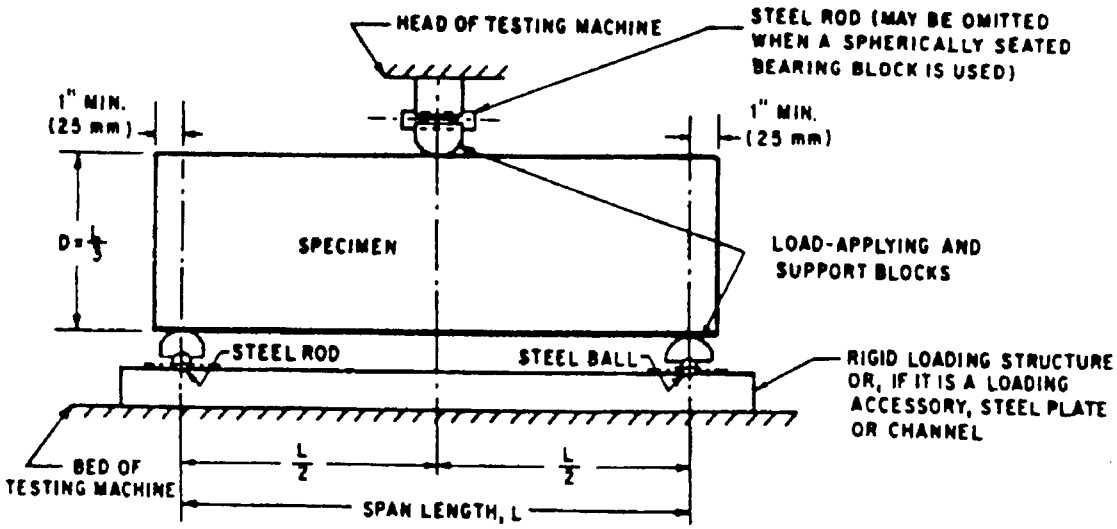
1. SCOPE

   a. This method is similar to AASHTO T 177 and covers the procedure for determining the flexural strength of concrete by the use of a simple beam with center-point loading.

2. APPARATUS

   a. The center-point loading method shall be used in the laboratory. The testing machine shall conform to the requirements of Sections 15, 16, and 17 of the Methods of Verification of Testing Machines (AASHTO T 67). In the field, a manually operated calibrated jack shall be used in conjunction with the field testing machine supplied by the Regional Materials Engineer. The apparatus shall incorporate the following requirements. The load shall be applied at the center point of the span, normal to the loaded surface of the beam, employing bearing blocks designed to ensure that forces applied to the beam will be vertical only and applied without eccentricity. The direction of the reactions shall be parallel to the direction of the applied load at all times during the test. The load shall be applied at a uniform rate and in such a manner as to avoid shock. The edges of the load-applying block and of the supports shall not depart from a plane by more than 0.051 mm.

   b. Caliper — A 1300 mm (12-in.) long caliper accurate to 0.25 mm (0.01 in.).



NOTE—Apparatus may be used inverted.

Figure 1: Diagrammatic View of Apparatus
For Flexure Test of Concrete by Center-point Loading Method

3. TEST SPECIMEN

   a. As nearly as practicable, the test specimen, as tested, shall have a span three times its depth. The test specimen shall be formed and stored as prescribed in WSDOT Test Method No. 808.

4. PROCEDURE

a. Turn the specimen on its side with respect to its position when molded, and center it on the supporting bearing blocks. The load-applying block shall be brought in contact with the upper surface at the center line between the supports.

b. Bring load applying block in full contact with the beam surface by applying a 3.1 N (100 lbs.) preload. Check to ensure that the beam is in uniform contact with the bearing blocks and the load applying block.

c. If load is applied with a hand pump, load the beam by applying the load at a rate of one full pump stroke per second. When the applied load is about 125 N (4,000 lbs.), reduce the full pump stroke to about a ½-pump stroke and maintain the one second stroke rate.

Rate of load application for screw power machines, with the moving head operating at 1.3 mm (0.05 in.) per minute when the machine is running idle, is acceptable.

5. MEASUREMENT OF SPECIMENS

a. Determine the beam dimensions, width (b) and depth (d), by averaging two measurements for width and two measurements for depth. The measurements shall be taken at the failure plane to an accuracy of 1.3 mm (0.05 in.).

6. CALCULATION

a. The modulus of rupture is calculated as follows:

$$R = \frac{3Pl}{2bd^2}$$

where:

R = Modulus of rupture in MPa or psi

P = Maximum applied load indicated by the testing machine in N or lb•f

l = Span length in mm or inches

b = Average width of specimen in mm or inches

d = Average depth of specimen in mm or inches

7. REPORT

a. The report shall include the following:

(1) Identification number,

(2) Average width,

(3) Average depth,

(4) Span length in inches,

(5) Maximum applied load in pounds,

(6) Modulus of rupture calculated to the nearest 0.03 MPa,

(7) Defects in specimen, and

(8) Age of specimen.

b. All test results will be reported on DOT Form 350-042.

3:P:DP/MM

WSDOT FOP for AASHTO T 141

Method of Sampling Fresh Concrete

1. SCOPE

   a. This method covers the procedure for obtaining samples of fresh concrete from stationary and paving mixers; from truck mixers, agitators, or dump trucks; and from the discharge of placement systems such as pumps or conveyors. Sampling for quality control requires obtaining a complete single sample from the initial portion of the load (see below).

2. SIZE OF SAMPLE

   a. The size of the sample will be 1.5 times the volume of concrete required for testing but not less than 0.03 m^3.

3. PROCEDURE FOR SAMPLING

   a. The procedures used in sampling shall include the use of every precaution that will assist in obtaining samples that will be representative of the true nature and condition of the concrete being placed, as follows:

      (1) Sampling from stationary mixers, except paving mixers.

      The sample is obtained by passing a receptacle completely through the discharge stream of the mixer at approximately the middle of the batch, or by diverting the stream completely so that it discharges into a container. Care shall be taken not to restrict the flow from the mixer in such a manner as to cause the concrete to segregate. These requirements apply to both tilting and nontilting mixers.

      (2) Sampling from paving mixers.

      The contents of the paving mixer is discharged and the sample collected from at least five different portions of the pile.

      (3) Sampling from revolving drum mixers or agitators for concrete quality control.

      The sample of concrete taken for in a single sample testing of the state or contractor provided mix designs shall be taken from the initial portion of a load "after at least 0.4 m^3 (½ cy) of concrete has been discharged." Sampling is done by repeatedly passing a receptacle through the entire discharge stream, or by diverting the stream completely so that it discharges into a container. The rate of discharge of the batch shall be regulated by the rate of revolutions of the drum, and not by the size of the gate opening.

      (4) Sampling from open-top truck mixers, agitators, dump trucks, or other types of open-top containers.

      Samples are taken by whichever of the procedures described in paragraphs 3.a.(1), 3.a.(2), or 3.a.(3) is most applicable under the given conditions.

      (5) Sampling from pump or conveyor placement system for concrete acceptance.

      Sampling of fresh concrete is done at the end of the pump discharge or conveyor system. Sampling is done by repeatedly passing a receptacle through the entire discharge stream, or by diverting the stream completely so that it discharges into a container.

   b. The contractor shall exercise all necessary care to prevent segregation or contaminating the concrete sample in transporting the sample to the test site.

(1) Transport the individual samples to the place where fresh concrete tests are to be performed and specimens are to be molded. The individual portions shall then be combined and remixed the minimum amount necessary to ensure uniformity and in conformance with the time limits as specified. Keep the elapsed time between obtaining, performing all the tests, and molding the specimens as short as possible. Protect the sample from direct sunlight, wind, rain, and sources of contamination during the time of performing the tests and molding all specimens.

(2) Start tests for slump and air content, or both, within five minutes after remixing the sample. Complete tests as expeditiously as possible. Start molding specimens for strength tests within 15 minutes after sample was remixed.

4. Random Sample Selection

a. Concrete samples other than initial load samples or samples for questioned acceptance will be taken from each sublot by a random selection. Sublots are determined by the designated sampling frequency in the *Standard Specifications*. Random selection will be accomplished by using the random number table attached. The "X" value in the table is a decimal fraction of the sublot of concrete which will be used to determine the approximate cubic yard of concrete to be sampled.

In order to determine which "X" value to use, the table is first entered on a line chosen by chance. As a suggestion, select a line corresponding to the last two numbers on the first civilian license plate you see. Subsequent "X" values for following sublots on the same day are taken from the lines which follow. Start each day with an "X" value determined by chance in order to obtain a random selection.

The cubic yard (meter) selected for sampling will be "X" value multiplied by the sublot quantity. After the cubic yard for sampling has been selected, the load delivered which contains this cubic yard will be sampled as outlined in Section 3 of this test method.

Table of Random Numbers

	X		X		X		X		X
(1)	0.186	(21)	0.256	(41)	0.201	(61)	0.508	(81)	0.431
(2)	0.584	(22)	0.753	(42)	0.699	(62)	0.884	(82)	0.509
(3)	0.965	(23)	0.108	(43)	0.785	(63)	0.648	(83)	0.962
(4)	0.044	(24)	0.626	(44)	0.874	(64)	0.398	(84)	0.315
(5)	0.840	(25)	0.885	(45)	0.604	(65)	0.142	(85)	0.721
(6)	0.381	(26)	0.418	(46)	0.087	(66)	0.962	(86)	0.637
(7)	0.756	(27)	0.320	(47)	0.334	(67)	0.516	(87)	0.056
(8)	0.586	(28)	0.098	(48)	0.189	(68)	0.615	(88)	0.905
(9)	0.480	(29)	0.791	(49)	0.777	(69)	0.226	(89)	0.195
(10)	0.101	(30)	0.717	(50)	0.704	(70)	0.881	(90)	0.981
(11)	0.282	(31)	0.868	(51)	0.946	(71)	0.369	(91)	0.600
(12)	0.957	(32)	0.583	(52)	0.426	(72)	0.001	(92)	0.044
(13)	0.377	(33)	0.385	(53)	0.266	(73)	0.744	(93)	0.433
(14)	0.456	(34)	0.465	(54)	0.791	(74)	0.229	(94)	0.762
(15)	0.778	(35)	0.101	(55)	0.711	(75)	0.906	(95)	0.678
(16)	0.243	(36)	0.285	(56)	0.122	(76)	0.413	(96)	0.347
(17)	0.578	(37)	0.829	(57)	0.895	(77)	0.827	(97)	0.274
(18)	0.966	(38)	0.998	(58)	0.371	(78)	0.984	(98)	0.114
(19)	0.373	(39)	0.539	(59)	0.221	(79)	0.641	(99)	0.480
(20)	0.834	(40)	0.060	(60)	0.011	(80)	0.068	(100)	0.685

18:P:DP/MM

WSDOT FOP for AASHTO T 119

Method of Test for Slump of Portland Cement Concrete

1. SCOPE

   a. This procedure provides instructions for field testing and is in conformation with AASHTO T 119.

   b. This test is not applicable to nonplastic and noncohesive concrete, nor when the maximum nominal size of the coarse aggregate is over 50 mm (2 in.).

2. APPARATUS

   a. Slump cone conforming to AASTO T 119 (see Figure 1).

      The mold shall be provided with foot pieces and handles. The mold may be constructed either with or without a seam. The interior of the mold shall be relatively smooth and free from projections such as protruding rivets. The mold shall be free from dents. A mold which clamps to a ridged nonabsorbent base plate is acceptable provided the clamping arrangement is such that it can be fully released without movement on the mold.

   b. Tamping rod.

      16 mm (⅝ in.) diameter and approximately 600 mm (24 in.) long, having the tamping end rounded to a hemispherical tip the diameter of which is 16 mm (⅝ in.).

   c. A carpenter's tape measure or ruler with at least 3 mm (⅛ in.) gradations.

   d. Torpedo level.

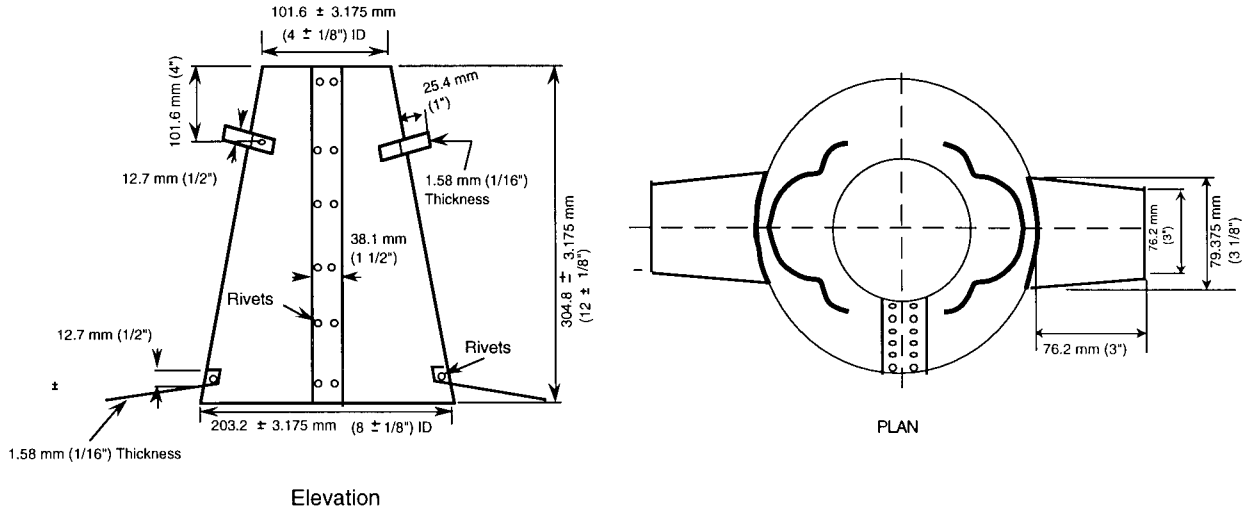


Figure 1: Mold For Slump Test

3. PROCEDURE

   a. The sample of concrete from which the slump test is to be performed shall be obtained in accordance with WSDOT FOP for AASHTO T 141. Testing shall begin within five minutes of obtaining the sample.

b. Dampen the mold and place it on a level, moist, nonabsorbent, rigid surface. It shall be held firmly in place during the filling by the operator standing on both foot pieces. From the sample of concrete obtained in accordance with FOP for AASHTO T 141, immediately fill the mold in three layers, each approximately one-third the volume of the mold. *One-third of the volume of the slump mold fills it to a depth of approximately 67 mm (2⅝ in.); two-thirds of the volume fills it to a depth of approximately 155 mm (6⅛ in.).*

c. Rod each layer with 25 strokes of the tamping rod (see Figure 2). Uniformly distribute the strokes over the cross-section of each layer. For the bottom layer, this will necessitate inclining the rod slightly and making approximately half of the strokes near the perimeter, and then progressing with vertical strokes spirally toward the center. Rod the bottom layer throughout its depth. Rod the second layer and top layer each throughout its depth, so that the strokes just penetrate into the underlying layer.

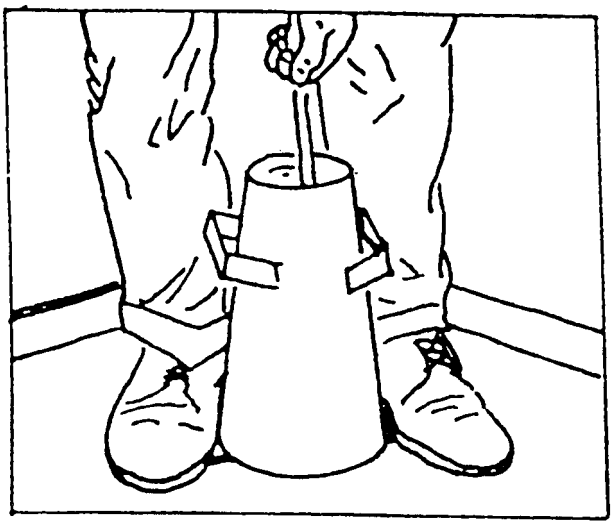


Figure 2

d. In filling and rodding the top layer, heap the concrete above the mold before rodding is started. If the rodding operation results in settling of the concrete below the top edge of the mold, add additional concrete to keep an excess of concrete above the top of the mold at all times, while maintaining the current rod count. After the top layer has been rodded, strike off the surface of the concrete by means of a screeding and rolling motion of the tamping rod. Immediately remove the mold from the concrete by raising it carefully in a vertical direction (see Figure 3). Raise the mold 300 mm (12 in.) in 5± 2 seconds by a steady upward lift with no lateral or torsional motion being imparted to the concrete. The entire operation from the start of the filling through removal of the mold shall be carried out without interruption and shall be completed within an elapsed time of 2½ minutes.

e. Measure the slump with a tape measure by determining the difference between the height of the mold and an average height over the displaced original center of the top of the specimen. Immediately invert the slump cone and set it next to the specimen, lay the tamping rod across the bottom of the mold so that it is over the test specimen. With a tape measure, measure the subsidence down to the displaced original center of the top of the specimen to the nearest 6 mm (¼ in.) (see Figure 4).

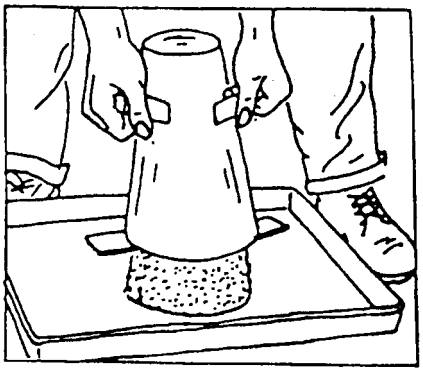


Figure 3

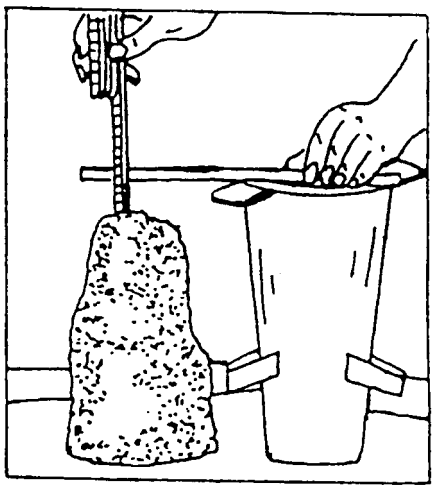


Figure 4

f. If a decided falling away or shearing off of concrete from one side or portion of the mass occurs, disregard the test and make a new test on another portion of the sample. If two consecutive tests on a sample of concrete show a falling away or shearing off of a portion of the concrete from the mass of the specimen, the concrete probably lacks necessary plasticity and cohesiveness for the slump test to be applicable.

4. REPORT

a. Record the slump in terms of milimeters (inches) to the nearest 6 mm (¼ in.) of subsidence of the specimen during the test.

19:P:DP/MM

WSDOT FOP for AASHTO T 152

Method of Test for Determination of Percent of Entrained Air in Portland Cement Concrete

1. SCOPE

   a. This method covers procedures for determining the amount of air entrained in fresh Portland cement concrete. This procedure uses the air-meter known as the Press-UR-Meter.

2. EQUIPMENT

   a. Press-UR-Meter — A Type B meter as described in AASHTO T 152 (4.1.2).

   b. Tools for placing and tamping specimen. Tamping rod shall have a 16 mm (⅝ in.) diameter and have an approximate length of 400 mm (16 in.).

   c. Straightedge — Approximately 460 mm × 25 mm × 3 mm (18 in. × 1 in. × ⅛ in.).

   d. Rags.

   e. Mallet with rubber or rawhide head weighing 0.57 kg ± 0.25 kg (1.25 ± 0.5 lb.).

   f. Hardbound (write-in-the-rain) — 125-mm × 200-mm (5 in. × 8 in.) book for recording dates when air-entrainment Type A meter was checked and calibrated.

3. CALIBRATION OF METER GAUGE

   a. Fill the base full of water.

   b. Screw the short piece of straight tubing into the threaded petcock hole on the underside of the cover. Clamp cover on the base with the tube extending down into the water.

   c. With both petcocks open, add water with syringe through the petcock having the pipe extension below *until all air is forced out opposite petcock*. Leave both petcocks open. Rocking the meter slightly is helpful in removing excess air.

   d. Pump the air pressure to a little beyond the predetermined initial pressure (indicated on the gauge or as shown in the log book). Wait a few seconds for the compressed air to cool to ambient temperature and then stabilize the gauge hand at the proper initial pressure by pumping or bleeding off as needed.

   e. Close both petcocks and immediately open needle valve exhausting air into the base. Wait a few seconds until the hand is stabilized. If all the air was eliminated and the initial pressure line was correctly selected, the gauge should read 0 percent in the result. If two or more tests show a consistent variation from 0 percent in the result, then change initial pressure line to compensate for the variation. Use the newly established initial pressure line for subsequent tests.

   f. Screw the curved tube into the outer end of the petcock and, by pressing on the thumb lever and controlling flow with the petcock lever, fill the 5 percent calibrating vessel (345 ml) level full of water from the base.

   g. Release the air at the free petcock. Open the other petcock and let the water in the curved pipe run back into the base. There is no 5 percent air in the base.

   h. With petcocks open, pump air pressure in the exact manner as outlined in paragraph 3.e., above. Close petcocks and immediately press the thumb lever. Wait a few seconds for exhaust air to warm to normal temperature, and for the needle to stabilize. The dial should now read 5 percent.

i. If two or more consistent tests show that the gauge reads incorrectly at 5 percent by more than +0.2 percent, then remove the gauge glass and reset the dial hand to 5 percent.

j. When the gauge hand reads correctly at 5 percent, additional water may be withdrawn in the same manner to check the results at 10 percent, 15 percent, and 20 percent.

k. Remove the extension tubing from threaded petcock hole before starting tests on concrete.

l. The above calibration procedure shall be performed at least at six-month intervals, at the start of a project, or weekly when meter is used during concrete placement.

m. Record the date of the calibration, the calibration results, and the name of the technician performing the calibration in the log book kept with each air meter.

4. PROCEDURE

a. The sample of concrete from which the air content test is to be performed shall be representative of the entire lot of concrete being delivered. It is obtained in accordance with WSDOT FOP for AASHTO T 141, Method of Sampling Fresh Concrete. Testing shall begin within five minutes of obtaining the last portion of the composite sample.

b. Place the concrete in the measuring bowl in three layers of approximately equal volume. Consolidate each layer of concrete by 25 strokes of the tamping rod evenly distributed over the cross section. After each layer is rodded, tap the sides of the measure smartly 10 to 15 times with the mallet to close any voids left by the tamping rod and to release any large bubbles of air that may have been trapped. Rod the bottom layer throughout its depth. The rod shall not forcibly strike the bottom of the measure. In rodding the second and final layers, use only enough force to cause the rod to penetrate the surface of the previous layer about 25 mm. Add the final layer of concrete avoiding overfilling.

c. Strike off the measuring bowl and thoroughly clean the rim of the measuring bowl to ensure an air tight seal; then place the top of the air meter on the bowl and fasten with the locking tabs.

d. Using rubber syringe, inject water through one petcock until all air is expelled through the opposite petcock. Jar meter or rock the meter gently until all excess air is expelled. Leave both petcocks open. With the built-in pump, pump air to the initial pressure on gauge. Wait a few seconds for the compressed air to cool to normal temperature, then stabilize the gauge hand at the proper initial pressure by pumping or bleeding off, as needed.

e. Close both petcocks and open the needle valve to release the air into the base. While holding the valve open, rap the meter with a mallet to relieve local restraint. Lightly tap the gauge with the finger to stabilize the hand on dial. Read the percentage of air in the concrete on the dial.

f. Open both petcocks to release the pressure and then remove the cover. Clean up the base, cover, and petcock openings.

5. REPORTS

a. Record the results as the percent of air in the concrete on DOT Forms 350-566 and 450-001.

21:P:DP/MM

WSDOT FOP for AASHTO T 121

Method of Test for Weight per Cubic Foot and Cement Factor

1. SCOPE

   a. AASHTO T 121 covers the procedure for determining the weight per cubic foot of freshly mixed concrete and gives formulas for calculating the volume of concrete produced from a mixture of known quantities of the component materials and the actual cement factor.

2. APPARATUS

   a. Balance — A balance or scale accurate to within 0.3 percent of the test load at any point within the range of use.

   b. Tamping Rod — A round, straight steel rod, 16 mm (⅝ in.) diameter and approximately 600 mm (24 in.) long, having the tamping end rounded to a 16 mm (⅝ in.) diameter hemispherical tip.

   c. Measure — A cylindrical metal measure, preferably provided with handles. The measure shall be watertight, preferably machined to accurate dimensions on the inside. It shall be reinforced around the top with a 2.00 mm to 1.70 mm (No. 10 to No. 12) gage steel band 37.5 mm (1.48 in.) wide. The top rim shall be smooth and plane to 0.25 mm (0.01 in.). The capacity and dimensions of the measure shall conform to the limits in Table 1.

Table 1
Dimensions of Measures

Capacity m^3 ($ft.^3$)	Inside Diameter mm (in.)	Inside Height mm (in.)	Thicknesses of Metal (minimum mm) (minimum in.) Bottom	Thicknesses of Metal (minimum mm) (minimum in.) Wall	Nominal Maximum Size of Coarse Aggregate mm (in.)
0.007 (¼)	203 ± 2.54 (8.0 ± 0.1)	213 ± 2.54 (8.4 ± 0.1)	5.1 (0.20)	3.0 (0.12)	25* (1)*
0.014 (½)	254 ± 2.54 (10.0 ± 0.1)	279 ± 2.54 (11.0 ± 0.1)	5.1 (0.20)	3.0 (0.12)	50 (2)
0.028 (1)	356 ± 2.54 (14.0 ± 0.1)	284 ± 2.54 (11.2 ± 0.1)	5.1 (0.20)	3.0 (0.12)	76 (3)

*Measuring bowl may be the same measuring bowl as is used for determining entrained air content WSDOT FOP for ASHTO T152.

   d. Mallet — A mallet (with a rubber or rawhide head) weighing 0.57 ± .0.23 kg (1.25 ± 50 lb.) for use with measures of approximately 0.014 m^3 (½ $ft.^3$) or weighing 1.02 ± 0.23 kg (2.25 ± 0.50 lb.) for use with measures of 0.028 m^3 (1 $ft.^3$).

   e. Strike-off Plate — A flat rectangular metal plate at least 6 mm (¼ in.) thick or a glass or acrylic plate at least 12 mm (½ in.) thick, with a length and width at least 50 mm (2 in.) greater than the diameter of the measure with which it is to be used. The edges of the plate shall be straight and smooth within tolerance of 1.5 mm (1/16 in.).

3. CALIBRATION OF MEASURING BOWL

Fill the measure with water at a temperature between 16°C and 29°C (60°F and 85°F) and cover with a piece of glass in such a way as to eliminate bubbles and excess water.

Determine the net mass (weight) in the measure to an accuracy of ± 0.1 percent.

Measure the temperature of the water and determine its unit mass (weight), from Table 2, interpolating if necessary.

Calculate the volume of the measure by dividing the mass (weight) required to fill the measure by the unit mass (weight) of the water at the measured temperature, from Table 2.

Table 2
Unit Mass of Water
15°C to 30°C

°C	(°F)	kg/m³	(lb./ft.³)	°C	(°F)	kg/m³	(lb./ft.³)
15	(59.0)	999.10	(62.372)	23	(73.4)	997.54	(62.274)
15.6	(60.0)	999.01	(62.366)	23.9	(75.0)	997.32	(62.261)
16	(60.8)	998.94	(62.361)	24	(75.2)	997.29	(62.259)
17	(62.6)	998.77	(62.350)	25	(77.0)	997.03	(62.243)
18	(64.4)	998.60	(62.340)	26	(78.8)	996.77	(62.227)
18.3	(65.0)	998.54	(62.336)	26.7	(80.0)	996.59	(62.216)
19	(66.2)	998.40	(62.328)	27	(80.6)	996.50	(62.209)
20	(68.0)	998.20	(62.315)	28	(82.4)	996.23	(62.192)
21	(69.8)	997.99	(62.302)	29	(84.2)	995.95	(62.175)
21.1	(70.0)	997.97	(62.301)	29.4	(85.0)	995.83	(62.166)
22	(71.6)	997.77	(62.288)	30	(86.0)	995.65	(62.156)

4. PROCEDURE

a. The sample of concrete from which the unit weight test is to be performed shall be representative of the entire lot of concrete being delivered. It is obtained in accordance with WSDOT FOP for AASHTO T 141, Method of Sampling Fresh Concrete. Testing may be performed in conjunction with WSDOT FOP for AASHTO T 152 determining percent entrained air in fresh concrete.

b. Sequence of Operations — The measure shall be filled to ⅓ capacity and the mass of concrete rodded with the number of strokes prescribed in paragraph 4(C), evenly distributed over the cross-section. The measure shall then be tapped and filled to ⅔ capacity, the mass of concrete again rodded, the measure tapped as before, and finally filled to overflowing, rodded and tapped as before.

c. Rodding for Slump Greater Than 75 mm (3 in.) — Place the concrete in the measure in three layers of approximately equal volume. Rod each layer with 25 strokes of the tamping rod when the 0.014 m³ (1 ft.³) or smaller measures are used, and 50 strokes when the 0.028 m³ (0.5 ft.³) measure is used. Rod the bottom layer throughout its depth. The rod shall not forcibly strike the bottom of the measure. Distribute the strokes evenly over the cross-section of the measure and for the top two layers, penetrate about 25 mm (1 in.) into the underlying layer. After each layer is rodded, tap the sides of the measure smartly 10 to 15 times with the appropriate mallet to close any voids left by the tamping rod and to release any large bubbles of air that may have been trapped. Add the final layer avoiding overfilling.

d. Rapping — The exterior surface of the measure is rapped smartly 10 to 15 times.

e. Strike-off, Cleaning, and Weighing — After consolidation of the concrete, the top surface is struck off and finished smoothly with a flat cover plate using great care to leave the measure just level full. All excess concrete is then cleaned from the exterior and the filled measure weighed to the nearest 0.045 kg (0.1 lb.).

f. For concrete slump less than 1-in. internal vibrations shall be used as follows:

g. For slump between 1-in. and 3-in. internal vibration on rodding may be used.

5. CALCULATIONS

a. Mass per m^3 (wt./$ft.^3$) — Calculate the net mass of the concrete by subtracting the mass (weight) of the measure from the gross mass (weight).

$$W = \frac{w}{v}$$

where:

W = Mass (weight) per m^3 (weight per $ft.^3$)

w = Mass (weight) of concrete in measure

v = Volume of measure

b. Volume of Concrete — Calculate the volume of concrete produced per batch as follows:

$$S = \frac{Wa + Wf + Wc + WW}{W}$$

where:

S = Volume of concrete in cubic meters (feet) per batch

Wa = Total mass (weight) of cement in batch in kilograms (pounds)

Wf = Total mass (weight) of fine aggregate, including moisture as batched, in kilograms (lbs.)

Wc = Total mass (weight) of Coarse Aggregate, including moisture as batched, in kilograms (pounds)

Ww = Total mass (weight) of water added to batch in kilograms (pounds)

W = Unit mass (weight) of fresh concrete as determined in paragraph 5(A)

c. Cement Factor — Calculate the “actual” cement factor as follows:

$$CF = \frac{\text{kg of cement}}{S}$$

where:

CF = Ccement factor

S = Volume of concrete per batch in cubic meters (feet) as determined in paragraph 5.b.

Any discrepancy in cement content from that specified should be corrected by increasing or decreasing the masses (weights) of aggregates batched.

Note: An increase of 1 percent in the weight of aggregates will usually result in a decrease of 1 percent in the cement content, or vice versa. Changes in batch masses (weights) for the purpose of correcting the cement factor should be made proportionally among all sizes of aggregate.

F. Supplemental instructions for unit weight determination on low slump (paving) concrete

When low slump concrete (slump: 25 mm (1 in.) or less) is used and being consolidated by vibration, the method of filling the mass (weight) per 0.02831 m^3 (1 $ft.^3$) bucket is changed from that outlined in paragraphs 4(a), b., and c. to the following:

The bucket is filled completely with concrete and consolidated by using a hand vibrator used for making concrete beams. Eight insertions of the hand vibrator shall be used for the 0.02831 m^3 (1 $ft.^3$) bucket and four insertions used for the 0.0146 m^3 (1 $ft.^3$) bucket. The insertions should reach the bottom of the bucket and be spaced evenly over the surface of the concrete, with no insertion being closer than 75 mm (3 in.) to the edge of the bucket. Maximum diameter of the vibrating head shall be 38.1 mm 1 ½ in.).

6. REPORTS

a. Record results as mass per m^3 (weight per $ft.^3$), volume of concrete per batch, and/or cement factor on DOT Form 350-566.

20:P:DP/MM

WSDOT Test Method No. 808

Method for Making Flexural Test Beams

1. SCOPE

   a. This method covers the procedures for molding and curing Portland cement concrete flexural test beams.

2. EQUIPMENT

   a. Test beam molds, 150 mm × 150 mm × 550 ± 13 mm (6 in × 6 in. × 21 ± ½ in.) or 200 mm × 200 mm × 670 ± 13 mm (8 in. × 8 in. × 26 ± ½ in.).

   b. Vibrator, capable of 7,000 vibrations per minute with a diameter not less than 19.0 mm (¾ in.) or greater than 38.1 mm (1½ in.).

   c. Tamping Rod — The tamping rod is a round, straight steel rod 16.0 mm (⅝ in.) diameter and approximately 610 mm (24 in.) long, having the tamping end rounded to a 16.0 (⅝ in.) mm diameter hemispherical tip.

   d. Mallet — A mallet with a rubber or rawhide head weighing 0.57 ± 0.23 kg (1.25 ± 0.50 lb.).

   e. Assorted tools such as scoops, shovels, etc.

3. PROCEDURE

   a. For laboratory made beam specimens, mix sufficient concrete to make all the required specimens from one batch. Each beam specimen requires approximately 0.015 m^3 (.45 $yd.^3$) of concrete.

      For field-made beam specimens, the concrete sample is obtained in accordance with WSDOT Test Method No. 803, Method of Sampling Fresh Concrete. Making of the beam specimens shall begin within 15 minutes of remixing the sample.

   b. Mold specimens as near as practicable to the place where they are to be stored during the first 24 hours.

   c. Assemble the molds on a rigid surface free from vibration and other disturbances. Remix the concrete to a uniform appearance. When the method of consolidation is by internal vibrators, the mold is filled in a single layer. Make sure that each shovel or scoop of concrete is representative of the batch. When the method of consolidation is by rodding, the mold is filled in two layers with each layer being rodded one time for each 1290 mm^2 (2 $in.^2$) of surface area. The rodding should be distributed evenly over the entire surface. On the succeeding layers, the rod should not penetrate the previous layer more than 13 mm (½ in.). Afer each layer is rodded, tap the outsides of the mold lightly 10 to 15 times with a mallet.

   d. Insert the vibrator at intervals not to exceed 150 mm (6 in.) along the centerline of the long dimension of the beam. For specimens wider than 150 mm (6 in.), use alternating insertions along two lines at least 50 mm (2 in.) away from the sides of the mold. Withdraw the vibrator so that no air voids are left in the concrete. Then tap the mold lightly 10-15 times with mallet.

   e. Finish the surface of the concrete by striking off with a straightedge. Use the minimum amount of manipulation necessary to leave a flat surface that has no depressions or projections larger than 3.2 mm (⅛ in.) and is level with the sides of the mold.

   f. The top surface of the laboratory-made specimen shall be covered with a saturated towel and a plastic sheet to prevent moisture loss from the concrete.

For the field made specimen, the top surface of the beam shall be sprayed with the same curing compound as is used for the pavement and covered with a plastic tarpaulin.

4. STORAGE AND HANDLING

The method of storing and handling the beam specimen depends on the purpose for which the beam is intended. Two methods are provided as follows:

a. Laboratory Method — Beam for determining the acceptability of a contractor-provided paving mix.

Cover the beam to prevent moisture loss and allow beam to remain undisturbed for an initial cure period of 24 ± 4 hours at a temperature of 16° to 27°C (60° to 80°F). After the initial cure period, the beam will be removed from the mold and within 30 minutes stored in saturated limewater at 23° ± 2°C (73.4° ± 3°F) for a minimum of 20 hours prior to testing. Surface drying of the beam between removal from the limewater and completion of testing shall be prevented. Relatively small amounts of drying of the test beam surfaces induces tensile stress in the extreme fibers that will markedly reduce the indicated flexural strength.

b. Field Method — Beam for determining the flexural strength of the in-place pavement.

After applying the curing compound to the top surface, cover the beam specimen with white reflective sheeting and allow beams to remain undisturbed for an initial cure period of 24 ± 4 hours at ambient conditions. After the initial cure period, remove the specimen from the mold and cure the specimen either by:

(1) Burying the specimen in wet sand making sure that the specimen is never allowed to become surface dry. Temperature of the sand should be similar to the concrete pavement temperature, or

(2) Wrap the beam in a saturated towel, place in a plastic bag, and seal the opening. The plastic should be at least 4 mils thick. Leave the specimen on the pavement in the vicinity where it was molded until time to test. Take specimen to the testing location and store in lime water at 23° ± 2.8°C (73.4° ± 5°F) for 24 ± 4 hours immediately before time of testing to ensure uniform moisture condition from speciment to specimen.

Note: The beam specimen must be kept in a surface moist condition or wet environment for the entire time in storage **and** testing. Even minor amounts of surface drying of the specimen induces extreme fiber stresses which can markedly reduce the flexural strength.

5. TESTING

a. Beam specimens are tested for flexural strength in accordance with WSDOT Test Method No. 802.

9:P:DP/MM

WSDOT FOP for AASHTO T 23

Method of Making, Handling, and Storing Concrete Compressive Test Specimens in the Field

1. SCOPE

   a. The procedure describes the method for making, handling, and storage of concrete compressive strength test specimens in the field.

   b. The number of cylinders made will be as follows:

      Testing for determining the compressive strength at 28 days, a set of two-cylinder specimens shall be made from the same sample.

      Testing for compressive strength at ages less than 28 days, a single-cylinder specimen for each test age will be sufficient.

2. APPARATUS

   a. The following equipment will be kept on hand at each concrete job and used in the preparation of test cylinders:

      A steel rod, 16 mm (⅝ in. diameter, approximately 610 mm (24 in.) long, with one end rounded to a 16 mm (⅝ in.) diameter hemispherical tip for preparing 150 mm (6-in.) × 300 mm (12-in.) cylinders. A steel rod 10 mm (⅜ in.) diameter hemispherical tip for preparing 100 mm (4-in.) 200 mm (8-in.) cylinder.

      A supply of base plates and cover plates. These may be of steel, glass, or form plywood.

   b. A supply of sand or earth for initial cylinder protection. As an alternative, cure boxes providing a minimum thickness of 50 mm (2 in.) of styrofoam insulation may be used. Cure boxes shall have a protective exterior of plywood or other suitable material to prevent damage to the insulation.

   c. An optional temporary storage tank equipped with sufficient heaters to maintain the water at 23° ± 2°C (73.4° ± 3°F) while cylinders are being stored.

Heater –	Kneisley Electric Co.	Model-H-1900
	Gilson Tank Heaters	Model-HM-650
Tank –	6 ft. × 2 ft. × 2 ft. Galvanized Stock Tank	
Recirculating Pump –	Gilson	Model-HM-655
	Little Giant	Model P-AAA
	Pump Company	Cat No. 523924

3. MAKING CONCRETE CYLINDERS

   a. The sample of concrete from which the test cylinders are to be made shall be representative of the entire lot of concrete being delivered. It is obtained in accordance with AASHTO T 141, Method of Sampling Fresh Concrete. Making of the test specimens shall begin within 15 minutes of remixing the sample.

   b. Place the test molds on a firm, flat, and level surface to prevent distortion of the bottom surface. When more than one specimen is to be made from the same batch, make all specimens simultaneously. Place and rod the first layer in each mold before proceeding to the second layer and so on through the third layer. Place the first layer of concrete in the mold with a circular motion of the scoop to distribute the concrete evenly in the mold to approximately ⅓ the depth of the cylinder. Rod the layer 25 times with the tamping rod,

penetrating full depth into the layer, but not forcibly striking the bottom of the mold. Distribute the 25 strokes evenly over the surface of the layer. Place two additional layers in the mold, each approximately one-third the volume of the mold, and rod each layer with 25 strokes of the tamping rod. When rodding successive layers, penetrate approximately 25 mm (1 in.) into the previous layer with each stroke. After each layer is rodded, pat the sides of the mold lightly by hand to release any entrapped air along the sides of the mold.

c. After the third layer has been rodded and the side of the mold has been patted, about 6 mm (¼ in.) of surplus concrete should remain above the top of the mold. Finishing the top of the cylinder will be done as follows:

(1) If initial curing of the cylinders will be done by burying the cylinders in earth or by using a cure box that is placed over the cylinders, move the cylinders with the excess concrete to the location where the cylinders will be initially cured. Finish the top of the cylinder with the tamping rod, or

(2) If initial curing of the cylinders will be done in a chest-type curing box, before moving the cylinders, finish the top of the cylinders with the tamping rod and move the finished concrete specimen to the cure box.

Finishing the top of the specimens with the flat bar will be accomplished by using a sawing motion across the top of the mold. The finished surface of the cylinder should be flat with no projections or depressions greater than 3 mm (⅛ in.).

Move the specimen with the bottom supported to prevent a convex bottom surface. Do not distort cylinder by squeezing the side of the mold when lifting the specimen. Avoid jarring, striking, or scarring the specimen when moving to initial curing place.

d. The initial curing place must be firm, level, free from vibrations, and other disturbances. Cylinders must be placed and secured to ensure that the cylinder axis will remain vertical throughout the initial cure period.

When the specimen is secured in the initial cure location, place a cover plate on top. If the cylinders are initially cured by burying, pile earth around the cylinder so it is imbedded to within 50 mm (2 in.) of the top. The portion of the cylinder protruding above the earth shall be protected from exposure to direct sunlight and wind. If a cure box is used for initial cure, place the box over the top of the cylinder or close lid to ensure a constant cure environment.

The initial cure period shall be 24 ± 4 hours, and specimens shall not be disturbed during this time.

Cylinders as cured under these conditions are considered to be stored under conditions equivalent to an ambient temperature of 16° to 27°C (60° to 80°F).

4. TRANSPORTING CYLINDERS

After the 24 ± 4 hours initial cure, the cylinders will be transported to the laboratory for storing under standard conditions. When cylinders are removed from initial cure, they shall be capped with a plastic lid which will be secured with tape. Cylinder identity will be marked on the lid along with the date the concrete specimen was made. If the lid is not water tight, put cylinders in a plastic bag and secure the opening to prevent moisture loss.

When a concrete mix design contains 226.75 kg (500 lb.) or less cementatious material or a retarder additive, extra caution must be used when handling test cylinder specimens within the first 24 hours. Refer to the retarder manufacturer’s recommendations or advise from Olympia Service Center Materials Laboratory in handling these specimens.

While in transport, the cylinders shall be:

Secured in such a fashion that the cylinder axis shall be vertical,

Kept at a temperature comparable to that of initial curing,

Kept out of direct sunlight or exposure to wind, and

Protected from jarring, striking, and from scarring the surface.

If cylinders are to be shipped by means of commercial carrier, arrangements for safe shipment shall be made with FOSSC Materials Laboratory prior to shipping.

5. HANDLING AND STORAGE OF CYLINDERS

The method of handling and storage of concrete cylinders depends upon the purpose for which the cylinder is intended. Three methods have been provided as follows:

a. Method 1 — Cylinders for determining the acceptability of concrete.

After the 24-hour ± 4-hour initial cure period, the cylinders will be transported to the laboratory for curing under standard conditions. Specimens are removed from the mold and within 30 minutes stored in a moist condition with free water maintained on their surface at all times at a temperature of 23° ± 2°C (73.4° ± 3°F).

If unable to transport the cylinders to the laboratory within the specified time, the cylinders may be stored in the temporary storage tank for up to 72 additional hours. The water shall be kept at 23° ± 2°C (73.4° ± 3°F) when cylinders are being temporarily stored. While in storage, cylinders shall be fully immersed with the plastic lid removed.

b. Method 2 — Cylinders for evaluating the in-place strength of concrete in a structure prior to applying loads or stresses.

Store the test cylinders at or near the structure in a semi-sheltered location where the temperature of the test specimens will be approximately that of the concrete in the structure. Leave the specimens near the structure for as long as possible before shipping to the laboratory. During the storage time at the structure, keep the specimens shaded. Avoid extreme exposure to wind and sun as well as conditions of overprotection from weather variations. Cylinders without caps may be enclosed in a moisture-proof envelope. Curing under job conditions should be extended as long as possible. The cylinders should arrive at the laboratory the day before testing.

c. Method 3 — Cylinders for evaluating steam cured concrete.

Test cylinders for determining the time of stress loading are cured in the same manner as the member.

Test cylinders for determining compliance with 28-day strength requirements are cured in the same manner as the member until completion of the steam curing process and then transferred to a water bath or moist room at an ambient temperature of 16° to 27°C (60° to 80°F) until tested.

Test cylinders for determination of member or girder strength as a condition of early shipment are cured under the same conditions as the girder. They may be enclosed in a moisture-proof envelope.

As an alternative to shipping to a WSDOT laboratory, testing may be done using the producer’s equipment, provided that satisfactory evidence has been furnished that such equipment, together with testing procedures, comply to accepted standards of testing.

6. DOCUMENTATION

Prepare a letter of transmittal on DOT Form 350-009 for each set of three cylinders from a tested batch of concrete. Be sure the cylinders are marked with the field number and the contract number.

Give all the information called for in the letter. The letter should state the test age. Ordinarily, this will be the designed age; duplicate cylinders prepared for other test ages should be so marked. Number the cylinders on each job as made. The percent of gravel passing 19 mm refers to the combined grading of the entire coarse aggregate. Calculate this to the nearest whole percent from the proportions used and from the latest screen analysis of each size of coarse aggregate. If the quantity of cement has been increased beyond the amount specified for that mix by reason of too fine grading, show the quantity actually used and make a note of this at the bottom of the letter. Show the total amount of water in the mix expressed in kilograms per cubic meter of Portland cement. This is the sum of the water added at the mixer and the water contained in the aggregates (as determined and described in AASHTO T 255) divided by the kilograms of cement in the batch. Show the slump as determined on the same batch. See AASHTO T 119 for the method of making the slump test. If an air-entraining admixture is used, show the quantity used in milliliter per cubic meter of Portland cement. For all air-entrained concrete, show the air content by test of the same batch. See WSDOT Test Method No. 805 for the method of determining air content.

7. PRECAUTIONS

a. The results of cylinder tests are of great value as a check on the strength of the concrete and as a measure of the quality of the cement and aggregate. A uniform method of preparation is necessary in order to secure reliable results. With strict attention to details, two operators' results can agree within 5 percent.

b. Following are the most error-producing deviations from standard practices in molding and curing test cylinders.

(1) Failure to secure representative sample of the concrete (either more or less coarse aggregate in cylinder than in concrete represented).

(2) Excessive puddling of concrete in the cylinders; this results in forcing coarse aggregate to the bottom leaving concrete rich in mortar at the top.

(3) Uneven ends, plane surface not used at bottom, and insufficient care used in striking off top surface.

(4) Failure to cover the top of the cylinder immediately after molding; this permits excessive evaporation of water.

(5) Failure to ship the cylinders to the laboratory promptly after curing period. If the cylinders arrive dried out, it is difficult to get them saturated in time for test.

(6) Failure to pile earth around the cylinder or to utilize cure boxes during first 24 hours. Cylinders have a large surface area exposed and are susceptible to temperature changes.

17:P:DP/MM

WSDOT Test Method No. 813

Field Method of Fabrication of 50-mm (2-in.) Cube Specimens for Compressive Strength Testing of Grouts and Mortars

1. SCOPE

   This method covers the fabrication of 50-mm (2-in.) cube specimens for compressive strength testing of grouts and mortars.

2. EQUIPMENT

   a. Specimen Molds

      Specimen molds for the 50 mm (2 in.) cube specimens shall be tight fitting. The molds shall not have more than three cube compartments and shall not be separable into more than two parts. The parts of the molds, when assembled, shall be positively held together. The molds shall be made of hard metal not attacked by the cement mortar. For new molds, the Rockwell hardness number shall not be less than HRB 55. The sides of the molds shall be sufficiently rigid to prevent spreading or warping. The interior faces of the molds shall be plane surfaces with a permissible variation of 0.025 mm (0.001 in.) for new molds and 0.50 mm (0.002 in.) for molds in use. The distances between opposite faces shall be 50 + 0.50 mm (2 ± 0.02 in.) for molds in use. The height of the molds, measured separately for each cube compartment, shall be 50 mm (2 in.) with permissible variations of +0.25 mm (+0.01 in.) and –0.125 mm (–0.005 in.) for new molds, and +0.25 mm (+0.01 in.) and –0.380 mm (–0.015 in.) for molds in use. The angle between adjacent interior faces, and between interior faces and top and bottom planes of the mold, shall be $\angle 90° \pm 0.5°$ measured at points slightly removed from the intersection of the faces.

   b. Base Plates

      Base plates shall be made of a hard metal not attacked by cement mortar. The working surface shall be plane and shall be positively attached to the mold with screws into the side walls of the mold.

   c. Tamper

      The tamper shall be made of a nonabsorptive, nonabrasive, nonbrittle material such as a rubber compound having a Shore A durometer hardness of 80 + 10, or seasoned oak wood rendered nonabsorptive by immersion for 15 minutes in paraffin at approximately 200°C (392°F), and shall have a cross-section of 13 mm (½ in.) × 25 mm (1 in.) and a length of about 125 to 150 mm (5 to 6 in.). The tamping face shall be flat and at right angles to the length of the tamper.

   d. Trowel

      A trowel which has a steel blade 100 to 150 mm (4 to 6 in.) in length, with straightedges with 16 ga. blade thickness.

3. PROCEDURE

   a. Three or more specimens shall be made for each period of test specified.

   b. Thinly coat the interior faces of the specimen molds with mineral oil or light cup grease such as petrolatum. Thinly coat the contact surfaces of the halves of each mold with the same heavy mineral oil or light cup grease. After assembling the molds, remove the excess oil or grease from the interior faces, and the top and bottom surfaces of each mold. Set the molds on the

plane nonabsorptive base plates that have been thinly coated with mineral oil, petrolatum, light cup grease, or an aerosol lubricant such as WD-40. Tighten the fastening screws until the mold is firmly attached to the base plate.

Apply petrolatum to the outside contact lines of the molds and the base plates so that the joints between the molds and the base plates are watertight.

c. Mold the specimens within an elapsed time of not more than 2 ½ minutes from completion of the original mixing of the mortar batch. Place a first layer of mortar about 25 mm (1 in.) deep in all the cube compartments (about one-half the depth of the mold).

d. For plastic mixes, tamp the mortar in each cube compartment 32 times in about 10 seconds making four rounds, each round perpendicular to the other and consisting of eight adjoining strokes over the surface of the specimen, as illustrated in Figure 1, below. The tamping pressure should be just sufficient to ensure uniform filling of the molds. The four rounds of tamping shall be completed in one cube before going on to the next. When the tamping of the first layer is completed, fill the compartments with the remaining mortar and then tamp as specified for the first layer. During tamping of the second layer, bring in the mortar forced out onto the tops of the molds after each round of tamping, by means of gloved fingers and the tamper, before starting the next round of tamping. On completion of tamping, the tops of all the cubes should extend slightly above the tops of the molds.

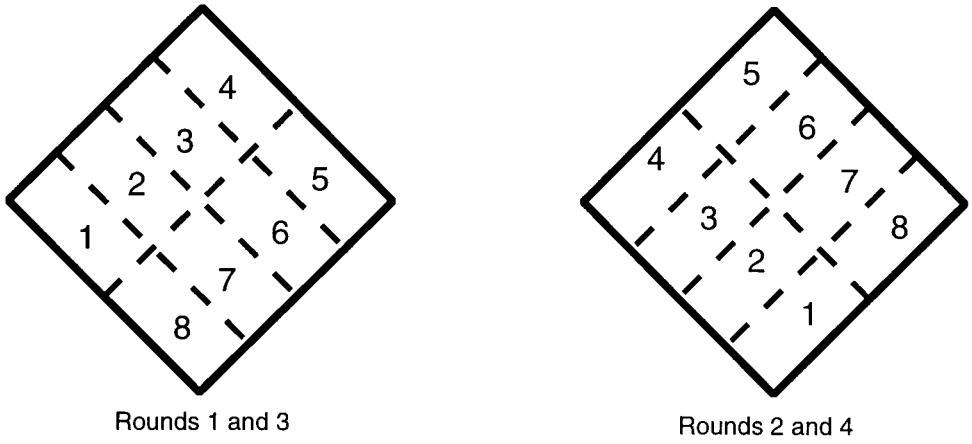


Figure 1

e. Bring in the mortar that has been forced out onto the tops of the molds with a trowel and smooth off the cubes by drawing the flat side of the trowel (with the leading edge slightly raised) once across the top of each cube at right angles to the length of the mold. Then, for the purpose of leveling the mortar and making the mortar that protrudes above the top of the mold of more uniform thickness, draw the flat trailing edge of the trowel (with leading edge slightly raised) once lightly along the length of the mold. Cut off the mortar to a plane surface flush with the top of the mold by drawing the straight edge of the trowel (held nearly perpendicular to the mold) with a sawing motion over the length of the mold.

f. When fabricating fluid mixes, steps d. and e. need not be followed. Instead, the cube mold is filled with mortar and cut off to a plane surface with a sawing motion over the length of the mold.

g. Immediately after molding, cover the sample with wet burlap, and place it in a plastic sack out of direct sunlight. Allow the sample to set undisturbed, away from vibration, for a minimum of four hours before moving. Deliver the sample to the district lab within 16 hours. Once

received in the lab, specimens are immediately placed in a moist curing room, all molded test specimens are kept on the base plates from 20 to 24 hours with their upper surfaces exposed to the moist air but protected from dripping water. If the specimens are removed from the molds before 24 hours, keep them on the shelves of the moist curing room until they are 24 hours old; and then immerse the specimens (except those for the 24-hour test) in saturated lime water in storage tanks made of noncorroding materials. Keep the storage water clean by changing as required.

h. Curing test specimens of material other than hydraulic cement shall be in conformance with the manufacturer's recommendations.

14:P:DP/MM

WSDOT FOP for ASTM C805

Rebound Hammer Determination of Compressive Strength of Hardened Concrete

1. SCOPE

   This test method is not intended as an alternative for strength determination. If the proper method is used, by an experienced operator, it can be a useful tool in estimating strength. In some specifications it has been designated as a criteria for evaluating early strength gain for opening work to traffic. The procedure provided herein is in conformance with ASTM C 805. In case of any apparent conflicts the procedure from the referenced standard shall apply.

2. EQUIPMENT

   a. Use hammer type N for testing concrete in building and bridge construction.

   b. Rebound hammers shall be serviced and verified/calibrated at least semiannually using a calibration anvil. Interim checks against a newly-adjusted hammer are recommended.

   c. Immediately after calibration a consistent object, such as a column or foundation should be tested and record the average readings. This item can now be used as a reference, in the same way as an anvil.

3. SELECTION OF TEST LOCATION

   a. Vertical, formed surfaces of concrete structures are preferred.

   b. Avoid form joints, honeycombs and porous areas. Avoid thin structural parts and specimens less than 100 mm (4 in.) thick.

4. PREPARATION OF TEST LOCATION

   a. Before testing, remove any plasterwork or coating or the cement slurry from the top surface of the concrete

   b. Slightly uneven surfaces shall be smoothed by hand with the carborundum stone supplied with the hammer.

   c. A minimum area of 150 mm (6 in.) in diameter will be ground to permit 10 test hammer impacts to be made on the mortar without hitting coarse aggregate particles.

   d The concrete must be ground off until its normal texture is exposed.

   e. With old concrete the excessively hard surface layer must be removed to a depth of about 13 mm (½ in.) For this work a high speed, hand-held, power grinder should be sufficient.

5. TESTING THE SPECIMEN

   a. Lightly pressing on the head of the impact plunger, release the plunger and allow it to slide out of the housing.

   b. Press the plunger against the point of the concrete surface to be tested, holding the hammer exactly at right angles to the surface being tested. Maintain pressure on the instrument and slowly increase the pressure on the housing to effect release of the plunger. Just before it disappears completely in the housing, the hammer is released.

   c. After the impact, the hammer mass rebounds by a certain amount which is indicated on the scale by the rider. Do not touch the push-button lock mechanism until after the hammer is released and has stabilized.

d. Estimate the rebound number on the scale to the nearest whole number and record the rebound number.

e. By simply removing the hammer from the spot tested, it is reset for a further test and at the same time the indication is canceled. The rider never returns quite to zero while the plunger is in its extended position..

f. Take ten readings from each test area. No two impact tests shall be closer together than 25 mm (1 in.). Examine the impression made on the surface after impact, and if the impact crushes or breaks through a near-surface air void disregard the reading and take another reading.

g. After having finished the tests, the plunger is locked in its rear position by means of the push-button. Locking should always be done after releasing the impact, with the plunger still inside the housing. The lock also serves for fixing the rebound reading after impact tests in dark or not easily accessible locations.

6. CALCULATION OF REBOUND NUMBERS AND INTERPRETATION OF REBOUND VALUES.

a. Discard readings differing from the average of 10 readings by more than 6 units and determine the average of the remaining readings. If more than two readings differ from the average by six units, discard the entire set of readings and determine rebound numbers at 10 new locations within the test area.

b. Converting the rebound number to estimated compressive strength (Mpa) (psi) shall be done after calculating the average of at least ten readings. Compute the average reading of the ten values accumulated. Convert this reading to estimated compressive strength using the calibration scale on the side of the hammer.

c. The test hammer is calibrated for horizontal impact direction, for testing vertical surfaces. On the side of the test hammer there is a label showing the curves used to convert rebound values to estimated compressive strength. If you are testing a vertical surface you use the 0° scale.

d. When using it on inclined or horizontal surfaces, the rebound value must be corrected. To correct the reading for an inclination angle, testing in an upwards direction use the +45° or +90° curves, testing downwards use the –45° or –90° curves. The direction of impact, horizontal, downward or upward must be the same for readings to be compared, unless a correction factor is established.

7. REPORTING TEST INFORMATION

All of the following should be recorded, if known:

Date and time of testing.

Identification of location tested in the concrete construction and the type and size of member tested.

Design strength of concrete tested.

Surface characteristics.

If the surface was ground and depth of grinding.

Type of form material used.

Curing conditions and type of exposure to the environment.

Hammer identification, serial number, and date of last calibration.

Air temperature at the time of testing.

Orientation of hammer during test.

Individual rebound test readings and average rebound number for each area tested.

Remarks regarding discarded readings or unusual conditions.

8. OTHER FACTORS THAT MAY AFFECT TEST RESULTS

Concrete at 0°C (32°F) or less may exhibit high rebound values, as will near surface coarse aggregate. The temperature of the hammer itself may affect the rebound number. Rebound hammers at –22°C (0°F) may exhibit lower readings. A lightweight aggregate mix may also show lower readings.

9. REFERENCED DOCUMENTS

ASTM Standard C805-94.

Operating instructions, Schmidt Concrete Test Hammer.

24:P:DP/MM

WSDOT FOP for ASTM C1064

Standard Method of Test for Temperature of Freshly Mixed Cement Concrete

1. SCOPE

    a. This test covers the determination of the temperature of freshly mixed Portland cement concrete.

2. APPARATUS

    a. Container — The container shall be made of nonabsorptive material and large enough to provide at least 75 mm (3 in.) of concrete in all direction around the sensor; concrete cover must also be a least three times the nominal maximum size of the coarse aggregate.

    b. Temperature Measuring Device — The temperature measuring device shall be capable of measuring the temperature of the freshly mixed concrete to the nearest 0.5°C (1°F) throughout the temperature range likely to be encountered..

3. CALIBRATION OF TEMPERATURE MEASURING DEVICE

    a. Each thermometer shall be checked for calibration whenever there is a question of accuracy.

4. SAMPLE LOCATIONS

    a. The temperature of the freshly mixed concrete may be measured in the transporting equipment, in forms, or in sample container; provided the sensor of the temperature measuring device has at least 75 mm (3 in.) of concrete cover in all direction around it.

5. PROCEDURE

    a. Place the temperature measuring device in the freshly mixed concrete so that the temperature sensing portion is submerged a minimum of 75 mm (3 in.). Gently press the concrete around the temperature measuring device at the surface of the concrete so that ambient air temperature does not affect the reading.

    b. Leave the temperature measuring device in the freshly mixed concrete for a minimum period of two minutes or until the temperature reading stabilizes, then read and record.

    c. Complete the temperature measurement of the freshly mixed concrete within five minutes after obtaining the sample.

6. REPORT

    a. Record the measured temperature of the freshly mixed concrete to the nearest 1°C (1°F).

22:P:DP/MM

WSDOT Test Method No. 609

Method of Test for Moisture-Density Relations of Soil

1. SCOPE

   a. This test is similar to AASHTO Test Method No. T 99 and is performed in order to provide the Engineer with a density standard for controlling compaction of fine-grained soils.

2. EQUIPMENT

   a. Mold — The mold shall be cylindrical in shape, made of metal, and shall have the capacity and dimensions indicated below. It shall have a detachable collar assembly approximately 64 mm (2½ in.) in height, to permit preparation of compacted specimens of soil-water mixtures of the desired height and volume. The mold may be of the "split" type, consisting of two-half-round sections or a section of pipe split along one element, which can be securely locked in place to form a cylinder as described above. The mold and collar assembly shall be so constructed that it can be fastened firmly to a detachable base plate.

   The mold shall have a capacity of 0.000943 ± 0.000008 m^3 (1/30 (0.0333 ± 0.0003 $ft.^3$), with an internal diameter of 101.6 ± 0.406 mm (4.000 ± 0.016 in.) and height of 116.43 ± .1270 mm (4.584 ± 0.005 in.).

   b. Rammer

      (1) Manually Operated — A metal rammer having a flat circular face of 50.8 ± .0.13 m (2.000 ± 0.005 in.) diameter, a wear tolerance of ± 0.25 mm (0.01 in.), and a mass (weight) 2.495 ± 0.009 kg (5.5 ± 0.02 lb.). The rammer shall be equipped with a suitable guide-sleeve to control the height of drop to a free fall of 305 mm ± 20 mm (12.00 ± 0.06 in.) above the elevation of the soil. The guide-sleeve shall have at least four vent holes no smaller than 9.5 mm (⅜ in.) diameter spaced approximately 90 degrees apart and approximately 19 mm (¾ in.) from each end and shall provide sufficient clearance so the free fall of the rammer shaft and head is unrestricted.

      (2) Mechanically Operated — A metal rammer which is equipped with a device to control the height of drop to a free fall of 305 ± 2.0 mm (12.00 ± 0.06 in.) above the elevation of the soil and uniformly distributes such drops over the soil surface. The rammer shall have a flat circular face of 50.8 ± 0.13 mm (2.000 ± 0.005 in.) diameter, a wear tolerance of 0.25 mm (0.01 in.), and a weight of 2.495 ± 0.009 kg (5.5 ± 0.02 lb.). See Figures 1 and 2.

      Note: The mechanical rammer apparatus shall be calibrated with several soil types, and the weight of the rammer adjusted, if necessary, to give the same moisture-density results as with the manually operated rammer. For additional information concerning the calibration of the free fall of the rammer, see AASHTO T 99.

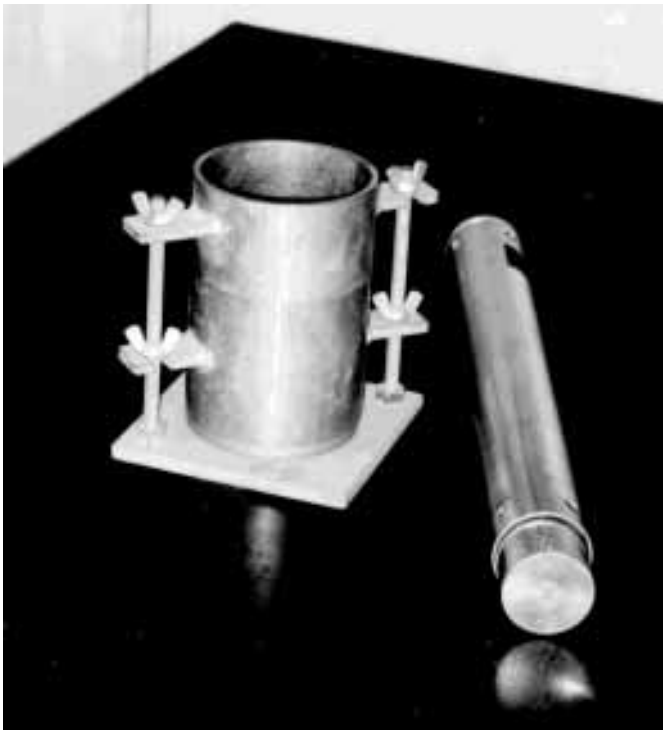


Figure 1: Proctor Mold and Rammer

c. Sample Extruder — A jack, lever frame, or other device adopted for the purpose of extruding compacted specimens from the mold.

d. Balances — A balance or scale of at least 15 kg capacity sensitive to 5 g and a balance of at least 1,000-g capacity sensitive to 0.1 gram.

e. Drying Oven — A thermostatically controlled drying oven capable of maintaining a temperature of 110° ± 5°C (230° ± 9°F) for drying moisture samples, or a suitable LP gas or gasoline stove.

f. Straightedge — A steel straightedge at least 250 mm (10-in. required by SMRL) in length, having one beveled edge.

g. Sieve — A 4.75 mm (U.S. No. 4) sieve conforming to the requirements of the Specifications for Sieves for Testing Purposes.

h. Mixing Tools — Miscellaneous tools such as mixing pan, spoon, trowel spatula, etc., or a suitable mechanical device for thoroughly mixing the sample of soil with increments of water.

i. Container — A flat pan, not less than 50 mm (2 in.) in depth, of such area as to provide for about 50 mm (2 in.) depth of sample for moisture absorption.

3. SAMPLE

a. If the soil sample is damp when received from the field, dry it until it becomes friable under a trowel. Drying may be in air or by use of drying apparatus such that the temperature of the sample does not exceed 60°C (140°F). Then thoroughly break up the aggregation in such a manner as to avoid reducing the natural size of individual particles.

b. Sieve an adequate quantity of the representative pulverized soil over the 4.75 mm (U.S. No. 4) sieve. Discard the coarse material, if any, retained on the 4.75 mm (U.S. No. 4) sieve.

c. Select a representative sample, weighing approximately 3 kg (7 lbs.) or more of the soil prepared as described in Paragraphs a. and b. above. If 3 kg (7 lb.) of dry materials are used, each 30 ml of water added will increase the water content approximately 1 percent.

4. PROCEDURE

a. Thoroughly mix the selected representative sample with sufficient water to dampen it to approximately 4 to 6 percent points below estimated optimum moisture content. At this moisture content, plastic soils, tightly squeezed in the palm of the hand, will form a cast which will bear only slight pressure applied by the thumb and fingertips; nonplastic soils will bulk noticeably.

b. Form a specimen by compacting the prepared soil in the 102 mm (4 in.) mold (with collar attached) in three equal layers to give a total compacted depth of about 127 mm (5 in.). Compact each layer by 25 uniformly distributed blows from the rammer dropping free from a height of 305 mm (12 in.) above the elevation of the soil. During compaction, the mold shall rest on a uniform, rigid foundation, such as provided by a cube of concrete weighing not less than 91 kg (200 lb.). Following compaction, remove the extension collar, carefully trim the compacted soil even with the top of the mold by means of the straightedge, and weigh. Multiply the mass (weight) of the compacted specimen and mold, minus the mass (weight) of the mold in kilograms, by 1060; and record the result as the wet density in kg/m^3 of the compacted soil or by 30 and record the result as the wet density in lbs./ft.^{3} or the compacted soil.

c. Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, weigh immediately, and dry to constant weight to determine the moisture content. The moisture sample shall weigh not less than 100 g.

d. Thoroughly break up the remainder of the material until it will pass a 4.75 mm (U.S. No. 4) sieve. Add water in sufficient amounts to increase the moisture content of the soil sample by 1 or 2 percent, and repeat the above procedure for each increment of water added. Continue this series of determinations until there is either a decrease or no change in the wet weight per m^3 (ft.^{3}) of the compacted soil.

5 . CALCULATIONS

a. Calculate the moisture content and the dry weight of the soil as compacted for each trial, as follows:

$$w = \frac{A - B}{B - C} \times 100$$

and:

$$W = \frac{W_1}{w + 100} \times 100$$

where

w = Percent of moisture in the specimen

A = Weight of container and wet soil (kg)

B = Weight of container and dried soil (kg)

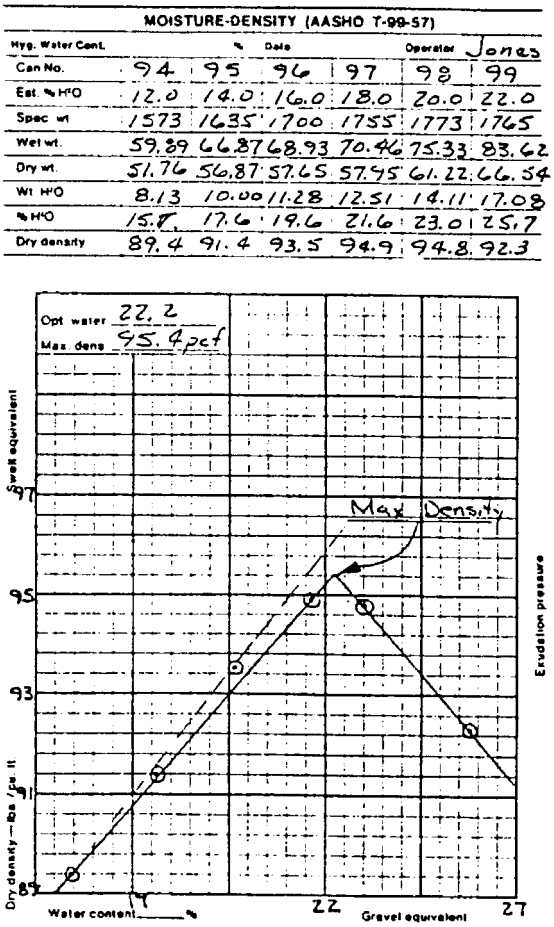
C = Weight of container (kg)

W = Dry density in kg/m^3 (lb/ft^3) of compacted soil

W_1 = Wet density in kg/m^3 (lb/ft^3) of compacted soil

6. MOISTURE-DENSITY RELATIONSHIP

a. Make calculations to determine the moisture content and corresponding oven-dry density for each of the compacted soil samples. Plot the oven-dry densities of the soil as ordinates and the corresponding moisture contents as abscissas (Figure 3).



MOISTURE-DENSITY (AASHO T-99-57)

Hyg. Water Cont.	%	Date			Operator	Jones
Can No.	94	95	96	97	98	99
Est. % H^2O	12.0	14.0	16.0	18.0	20.0	22.0
Spec wt	1573	1635	1700	1755	1773	1765
Wet wt.	59.89	66.87	68.93	70.96	75.33	83.62
Dry wt.	51.76	56.87	57.65	57.95	61.22	66.54
Wt H^2O	8.13	10.00	11.28	12.51	14.11	17.08
% H^2O	15.7	17.6	19.6	21.6	23.0	25.7
Dry density	89.4	91.4	93.5	94.9	94.8	92.3

Figure 3

b. Optimum Moisture Content — When the densities and corresponding moisture contents for the soil have been determined and plotted as indicated in paragraph a., connect the plotted points with a smooth line to produce a curve. The moisture content corresponding to the peak of the curve is termed the "optimum moisture content" of the soil under the compactive effort specified above.

c. Oversize — The maximum density in paragraph b. above is, as the test implies, the maximum density of 4.75 mm (U.S. No. 4) minus material only. A correction of this value will be necessary if it is to be compared with field density measurements which include oversize material. This correction is applied at the time the in-place field density determination is made on the job. The oversize percentage is determined by screening the material removed from the "Densometer" hole and performing the following calculation:

$$\text{Oversize } \% = \frac{\text{Dry weight of material retained on the 4.75 mm sieve (U.S. No. 4)} \times 100}{\text{Dry mass of total sample}}$$

A special density correction chart has been prepared to facilitate the density correction. Copies are available from the District Soils Engineer. By means of the chart, the "maximum density" will be corrected upward to compensate for the amount of oversize found in the field density determination material. This corrected value represents the standard to which the field density must be compared. A different density standard normally will be used for each field density sample with a different amount of oversize.

7. REPORTS

a. Record and plot results on the Moisture-Density Determination Work Sheet (Test Data Form 351-007).

5:P:DP/MM

WSDOT Test Method No. 613

Method for Determining In-place Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/Density Gauge

1. SCOPE

   a. This test method provides a procedure for determining the in-place density and moisture content of compacted soils and surfacing materials using a nuclear moisture/density device in the direct transmission mode. Descriptions and procedures are referenced to the most common model of nuclear gauge in use: Troxler Model 3430. Other types of gauges utilize similar measuring procedures but may have controls designated and operated in a different manner. This method includes procedures for determining field moisture content and gradation negative to the 4.75 mm (U.S. No. 4) sieve.

   b. A density measurement is defined as being the average of two density readings taken at the same location at 90 degrees to each other. A valid density measurement will consist of two density readings agreeing within ± 50 kg/m^3 (± 3 pcf) of each other.

   c. To determine if required compaction is being obtained in-place density tests must be taken at frequent intervals. Results of these tests are compared to density standards established for the material being compacted and are used as the basis for accepting or rejecting the work of the Contractor. Therefore, great care should be exercised to ensure accurate and consistent testing techniques.

   d. Each lift of material should be tested before subsequent lifts are placed. In selecting an area to be tested, sites should be chosen where the least compactive effort has been applied. If in-place densities do not meet specification requirements, additional compaction will be required and the area retested until such densities meet the minimum requirements.

2. EQUIPMENT

   a. Nuclear gauge kit comprised of:

      (1) Nuclear moisture/density gauge.

      (2) Standard block.

      (3) Drill rod guide and leveling plate.

      (4) Drill rod.

      (5) Battery charger including 12-volt adapter.

      (6) Log book.

      (7) Envelope containing instruction manual emergency procedures and other gauge related paperwork.

      (8) Carrying/transport case with foam inserts.

   b. Accessories necessary for performing test:

      (1) Striking Hammer — 1.81 kg (4 lb.) maximum, for driving drill rod.

      (2) 2.00 mm (U.S. No. 10) sieve for filling voids with fine native material

      (3) Square point shovel for preparing test site.

      (4) Sieves — 4.75 mm (U.S. No. 4) sieve with pan and cover. Additional larger size may be used to facilitate screening

(5) With approximate capacity of 50 kg, accurate to 1 percent.

(6) Sample Container — Capable of being sealed.

(7) Dry Device — Infrared propane heater, hot plate, fry pan, or any other device that will dry the sample, without altering the material being heated. Alcohol drying may be used, where permitted by Region Safety Policy.

(8) Utensils, such as spoons; sample drying pan; hot pad; or gloves; etc.

3. PROCEDURE

a. Preparation of Nuclear Density Gauge

(1) It is recommended that the machine be turned on when leaving the office so the required warm-up time can take place during the travel to the job site. Always carry the machine in the carrying case designed for it.

The standard count for the day should be taken at the job site in order that the background levels of radiation and other variables will be the same as when testing.

(2) Remove the Standard Block from the transport container and place it on a flat high-density surface, i.e., compacted soil, concrete or asphalt surface in an area at least 5 m (15 LF) from any vertical structure and 20 m (66 LF) or more from another nuclear gauge.

(3) Remove the instrument and place it on the standard block with the calculator end of the gauge facing the metal plate on the standard block. The instrument must be firmly seated within the raised edges and pushed against the metal plate. Remove the lock from the trigger.

(4) The position used for transport is the safe or shielded position and is also used to obtain the standard count i.e., MS (Moisture Standard) and DS (Density Standard).

(5) The DENSITY STANDARD COUNT is to be recorded in the Log Book and the count must be within 1 percent of the average of the previous four Density Standard Counts recorded in the Log Book.

The MOISTURE STANDARD COUNT is to be recorded in the Log Book and the count must be within 2 percent of the average of the previous four Moisture Standard Counts recorded in the Log Book.

Since all calibration and measurements are made as ratios to the reference standard, these changes will not affect the calibration. A log will be kept on the gauges with a record of the standard counts. Any sudden change in either of the numbers may indicate a defect in the instrument.

b. Preparation of Density Test Location

(1) In preparing the test site, the top 25 mm (1 in.) or 50 mm (2 in.) of material should be scraped away so that the moisture count accurately reflects the moisture content of the area. Do not alter materials, such as crushed surfacing top course, so as to result in a lift thickness of less than 50 mm (2 in.).

(2) Using the scraper plate supplied with the instrument, carefully scrape the surface to smooth condition, removing all dried and loose material. If the scraping action dislodges surface stones, remove them, fill the voids with fine native material screened through the 2.00 mm (U.S. No. 10), and lightly tamp the surface.

(3) Place the scraper plate in the middle of the site and drive the drill rod through the hole in the scraper plate into the soil using a hammer. Placing one foot on the plate will prevent it from slipping or otherwise damaging the site by allowing the drill rod to move from side to side. Safety glasses should be worn to protect the operators eyes in the event a breakage occurs either on the hammer face or the drill rod. The rod should be driven into the soil at least 50 mm (2 in.) further than the depth of measurement.

Note: The instrument is capable of taking measurements to a maximum depth of 203 mm (8 in.) in 50 mm (2 in.) increments.

(4) In most cases, the rod can be withdrawn simply by pulling upward on the rod cap. If required, the scraper plate can be lifted up and used to lightly tap and pull the rod from the soil. Care should be used to prevent damage to the hole in the ground.

(5) If a light mark is scribed around the scraper plate, it will be easier to position the gauge over the hole. The size of the plate and guide location matches the base of the gauge.

c. Nuclear Density Gauge Readings

(1) Place the instrument over the site so that the source rod lines up with the hole. Depress the trigger and push the handle down to the properly indexed position at the desired depth. Be certain that the trigger is indexed into the slot in the index rod and not pushed below the slot. This is easily determined by pulling up and down on the handle without depressing the trigger. Pull the gauge towards the calculator end to seat the source road against the side of the hole.

(2) Start the test and, after a one minute time period, note the wet density.

(3) Rotate the gauge at least 90 degrees and repeat the process of c(2). If the two readings agree within ± 50 kg/m^3 (± 3 pcf), a valid density measurement has been obtained. If not retract the source rod and move to a new location.

(4) Retract the source rod and remove the instrument from the test site.

d. Moisture and Gradation Analysis

(1) Obtain a representative sample of the material directly beneath the gauge. A portion of the sample should represent each of the 90-degree readings. Place the sample in a sealed container for further analysis. If a maximum density curve has not been developed for the material being tested, obtain a sample large enough to accommodate either WSDOT Test Method 606 for FOP for AASHTO T 99 whichever is applicable.

(2) Determine the moisture content per FOP for AASHTO T 255 and perform a grading analysis on the sample per the following to determine the amount passing or retained on the 4.75 mm (U.S. No. 4) sieve. In these expedient test methods, alcohol drying may be used in lieu of oven drying, where permitted by Region Safety policy. Under certain conditions where moisture content is of no concern or where it contributes an inconsequential percentage to the material passing the 4.75 mm (U.S. No. 4) sieve drying may be eliminated entirely.

(3) Moisture Determination

(a) Conventional oven method.

1) Weigh the sample in a tared container and record the mass (weight).

2) Dry the material to constant mass (weight) in the oven at 110° + 6°C (230° + 10°F) (approximately 24 hours).

3) Record the dry mass (weight).

(b) Expedient methods or drying source.

Any suitable drying source listed may be used when the material is dried for other tests or the method is sufficiently accurate for the type of material being tested. Use of alcohol drying requires the use of special equipment and safety precautions to avoid personal injury.

1) Weigh the sample in a tared container and record the mass (weight).

2) Dry to a constant mass (weight) stirring the sample to accelerate the removal of moisture. Constant mass (weight) is defined as, less than 1 g loss or less than 0.1 percent loss after an additional 30 minutes of drying.

3) Record the dry mass (weight).

(c) Calculations.

1) Calculate the percentage moisture using the following formula:

$$\text{Percent Moisture} = \frac{\text{wet mass (weight)} - \text{dry mass (weight)} \times 100}{\text{dry mass (weight)}}$$

(4) Gradation analysis.

This procedure is used as an expedient method to determine the distribution of particles relative to a 4.75 mm (U.S. No. 4) sieve. The sample used will be obtained from the density test location. Sample used for moisture content may be used for 4.75 mm (U.S. No. 4) sieve analysis.

(a) Determine the initial mass of the sample to nearest 1 g.

(b) Dry sample to a constant mass (weight) and record.

(c) Nest the sieves specified in order of decreasing size of opening from top to bottom and place the sample on the top sieve.

Shake by hand for a sufficient period and in such manner that, after completion, not more than 0.5 percent by weight of the total sample passes any sieve during 1 minute shaking. Hold the assembled sieve(s) provided with a snug-fitting pan and cover, in a slightly inclined position in one hand. Strike the side of sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turn the sieve about one sixth of a revolution at intervals of about 25 strokes.

(d) Remove and weigh the material on the 4.75 mm (U.S. No. 4) sieve and in the pan separately.

Note: The total weight of the material after sieving should check closely with original weight of sample placed on the sieves.

(e) Divide the weights on the sieves by the initial dry weight, determine the amount of material passing the 4.75 mm (U.S. No. 4) sieve.

Note: Calculate the percentage passing to the nearest percent.

4. REPORTS AND CALCULATIONS

a. Record all data on Field Density Test report, DOT Form 350-074 and Daily Compaction Test Report, DOT Form 351-015. (See Figures 4 and 5 for examples.)

b. It should be stressed that the numbers obtained with the nuclear gauge are simply in-place densities and tell the operator nothing in regard to relative compaction. In-place densities are to be compared with theoretical maximum density curves as developed by WSDOT Test Method Nos. 606 and FOP for AASHTO T 99.

c. Theoretical Maximum Density values require correction for oversize; that is, they must be corrected for the amount of material retained or passing the 4.75 mm (No. 4) sieve. Proceed with Paragraphs f. or g. as applicable.

d. Oversize Correction for FOP for AASHTO T 99.

(1) This Test Method is applicable to nongranular, silty materials with less than 30 percent retained on the 4.75 mm (U.S. No. 4) sieve. AASHTO T 99 may be run in the field or by the Region Materials Lab.

(2) To correct for oversize, use a "flower pot" curve and proceed as follows:

(a) Obtain theoretical maximum dry density from AASHTO T 99 and plot this value on the left axis of the graph. This value should also be entered on DOT Form 350-074 on line: "Maximum Density kg/m^3 (lbs./ft.^{3})"

(b) Obtain the specific gravity of the material retained on the 4.75 mm sieve and plot this value on the right axis of the graph. If this value is unknown, assume a value of 2.67.

(c) Draw a straight line between the two points plotted on the left and right axis of the graph.

(d) Enter the percent oversize (retained on 4.75 mm (U.S. No. 4) sieve) on the bottom or top axis of the graph and follow the vertical line until it intersects with the plotted diagonal line.

(e) From this point, draw a horizontal line to intersect the left axis. This value is the corrected maximum density and should be entered on WSDOT Form 350-74 on line: "Corrected Maximum Density from Flower Pot Curve kg/m^3 (lbs./ft.^{3})."

(f) Percent Compaction is then calculated by the formula:

$$\text{Density kg/m}^3\ (\%\ \text{MAX}) = \frac{\text{Dry Density kg (lbs./ft.}^3)}{\text{Maximum Density kg (lbs./ft.}^3)(\text{MAX Corr.})}$$

e. Determination of Corrected Maximum Density for WSDOT Test Method No. 606.

(1) This test method is applicable to granular, free-draining materials and to materials with 30 percent or more retained on the 4.75 mm (U.S. No. 4) sieve. Test Method 606 requires specialized equipment and is run only by the Region or FOSSC Materials Lab.

(2) To determine corrected maximum density, enter the graph with the percent passing the 4.75 mm (U.S. No. 4) sieve on the bottom axis. Follow the vertical line from this point until it intersects with the maximum density curve. From this point, draw a horizontal line to the right or left axis and read the corrected maximum density. This value should be entered on DOT Form 350-074 on line: "Maximum Density" from appropriate curve kg/m^3 (lbs./ft.^{3})."

(3) An alternative way to determine corrected Maximum Density, refer to computer generated chart for percent passing the 4.75 mm (U.S. No. 4) sieve. This value should be entered on DOT Form 350-074 on line "Maximum Density" from appropriate curve kg/m^3 (lb./ft.^{3}).

(4) Percent of compaction is then calculated by the formula:

$$\text{Density (\% MAX)} = \frac{\text{Dry Density kg/m}^3\ (\text{lbs./ft.}^3)\ (100)}{\text{Maximum Density kg/m}^3\ (\text{lbs.ft.}^3)}$$

5. PRECAUTIONS

a. The Nuclear Gauge is a radioactive device. The radioactive source cannot be turned off. Always exercise personnel protection standards when in the vicinity of the gauge. When not in actual use, make sure the source rod is in the fully retracted or "safe" position.

b. Only Licensed Operators are authorized to operate and handle the Nuclear Gauge. This is pursuant to WAC-246 and in agreement with the Department of Health, Radiation Control Unit and the U.S. Nuclear Regulatory Commission regulations Violation could cause suspension or revocation of Departmental Radioactive Materials Licenses.

c. In case of an accident involving the Nuclear Gauge, follow the "Emergency Handling Procedures" packed with each gauge and contact the Radiation Safety Officer as soon as possible.

d. The Nuclear Gauge is an expensive piece of equipment. Treat it with the respect it deserves NEVER leave the gauge unattended where it might be damaged by other equipment, traffic or the elements.

6. TROUBLESHOOTING

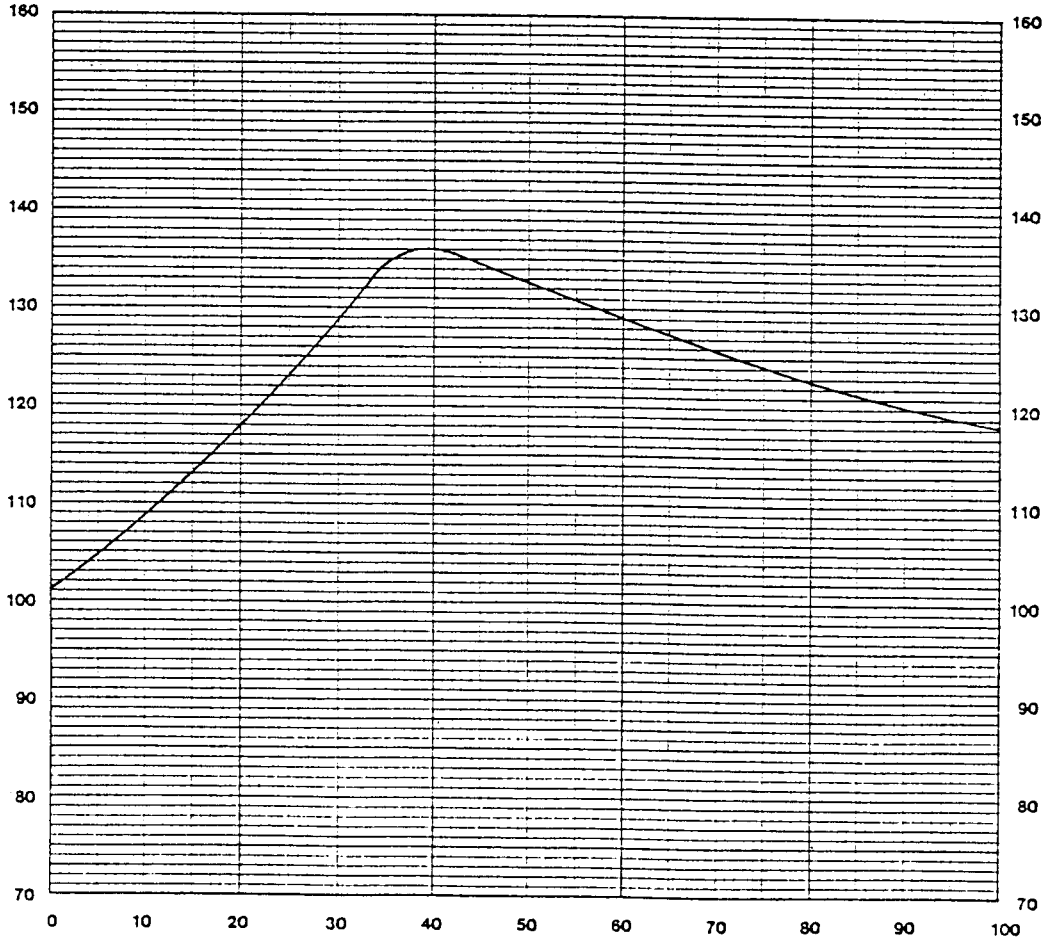
a. If the Moisture or Density Standard Counts do not check within 2 percent and 1 percent respectively, do not immediately assume that the gauge is malfunctioning. Take another Standard Count. If the second count is within the prescribed parameters proceed as normal If not, move the Standard Block to a new location making sure there are no outside influences such as other nuclear gauges, vertical surfaces, truck tires, trees or other materials containing hydrogen in the immediate vicinity (at least 20 m (66 LF)). Take another Standard Count. If the count is within the prescribed parameters proceed as normal. If not, take a second count. If the second count is still not within the prescribed parameters, it can be assumed the gauge is malfunctioning and should be removed from service.

8:P:DP/MM

MAXIMUM DENSITY CURVE

DEPARTMENT OF TRANSPORTATION
Materials Laboratory

LETTER NO. 72104
FIELD SAMPLE NO. 1
LAB NO. D-6261
CONT. NO. 3191 F.A. NO. I-5-3(316) S.R. NO. 5
SECTION Puyallup River to King Co. Line SOURCE OF MAT'L B-58
FIELD DESCRIPTION OF MATERIAL Crushed Surfacing
PERCENT PASSING # 4 45 DATE RECEIVED June 2, 1987



DISTRIBUTION:
Mat'l Files X
Gen'l Files X
Dist. Admin 3
Dist. Soils Engr. W.R Scott X
Proj. Engr. B.J. Walker (2)
Const. Engr. X
Soils Lab X

DOT Form 351-006 (X) Revised 3/84 537

The aproximate optimum moisture content is 7.8

The optimum moisture content of the No. 4 minus fraction, as determined by a standard proctor test, is 11.4

Specific Gravity Coarse 2.67

Specific Gravity Fine 2.69

J. R. STRADA, P.E.
Materials Engineer

By

Date June 5, 1987

Figure 1-a

DENS REV. 03/17/82 Lab Ma

CONTROL POINTS FOR DENSITY CURVES

PASS 4	MAXIMUM	LOOSE
0.0	101.2	84.2
20.5	118.4	96.1
28.4	126.8	100.8
42.2	135.7	103.2
58.2	129.9	94.7
100.0	118.4	79.2

M A X I M U M D E N S I T Y C U R V E

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	101.2	1	102.0	2	102.7	3	103.5	4	104.2
5	105.0	6	105.7	7	106.5	8	107.3	9	108.1
10	108.9	11	109.7	12	110.6	13	111.4	14	112.3
15	113.2	16	114.1	17	115.0	18	116.0	19	116.9
20	117.9	21	119.0	22	120.0	23	121.1	24	122.1
25	123.2	26	124.3	27	125.3	28	126.4	29	127.4
30	128.3	31	129.3	32	130.2	33	131.0	34	131.8
35	132.6	36	133.3	37	133.9	38	134.4	39	134.9
40	135.2	41	135.5	42	135.7	43	135.8	44	135.8
45	135.7	46	135.6	47	135.3	48	135.0	49	134.6
50	134.2	51	133.8	52	133.3	53	132.8	54	132.2
55	131.7	56	131.1	57	130.6	58	130.0	59	129.5
60	129.0	61	128.5	62	128.0	63	127.6	64	127.1
65	126.7	66	126.3	67	125.9	68	125.5	69	125.2
70	124.8	71	124.5	72	124.1	73	123.8	74	123.5
75	123.2	76	123.0	77	122.7	78	122.4	79	122.2
80	121.9	81	121.7	82	121.5	83	121.3	84	121.1
85	120.9	86	120.7	87	120.5	88	120.3	89	120.1
90	119.9	91	119.8	92	119.6	93	119.5	94	119.3
95	119.1	96	119.0	97	118.8	98	118.7	99	118.5
100	118.4								

L O O S E D E N S I T Y C U R V E

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	84.2	1	84.8	2	85.3	3	85.9	4	86.4
5	87.0	6	87.6	7	88.1	8	88.7	9	89.2
10	89.8	11	90.4	12	91.0	13	91.5	14	92.1
15	92.7	16	93.3	17	93.9	18	94.5	19	95.1
20	95.7	21	96.4	22	97.0	23	97.6	24	98.2
25	98.8	26	99.4	27	100.0	28	100.5	29	101.0
30	101.5	31	101.9	32	102.3	33	102.6	34	102.9
35	103.2	36	103.3	37	103.5	38	103.5	39	103.6
40	103.5	41	103.4	42	103.2	43	103.0	44	102.7
45	102.3	46	101.9	47	101.5	48	101.0	49	100.4
50	99.9	51	99.3	52	98.7	53	98.0	54	97.4
55	96.8	56	96.1	57	95.5	58	94.8	59	94.2
60	93.6	61	93.1	62	92.5	63	92.0	64	91.4
65	90.9	66	90.4	67	89.9	68	89.5	69	89.0
70	88.6	71	88.1	72	87.7	73	87.3	74	86.9
75	86.5	76	86.1	77	85.8	78	85.4	79	85.1
80	84.7	81	84.4	82	84.1	83	83.8	84	83.5
85	83.2	86	82.9	87	82.6	88	82.3	89	82.0

Figure 1-b

Washington State Department of Transportation

SOIL SAMPLE TESTS

JOB NO.	S.H. N.	SAMPLE NO.
Cont. 2702	SR- 82	LAB. NO.
SECTION		BIN NO.
M.P. 84.01 to KIONA		DATE REC'D.
FIELD DESCRIPTION		

GRADING ANALYSIS

WT. PASSING RETAINED	FRACTIONS WT.	FRACTIONS %	PASSING SIEVE	PASSING %	%	AS USED SIZE	AS USED %	%
-1½"			1½"					
1½"-1"			1"			¾"-3/8"		
1"-¾"			¾"					
¾"-⅜"			⅜"			3/8"-No. 4		
⅜" No. 4			No. 4					
Pass No. 4			10			Pass No. 4		
Total			40					
Est. Fract.			200					
Date (Coarse)						Specific Gravity		
Data(Fine)						Textural Class		

CONSTANTS

Operator

	LIQUID LIMIT	PLASTIC LIMIT	
Can No.			
Wet Wt.			
Dry Wt.			
Wt. H²O			
% H²O			
No. Blows			
L.L.			
P.L.			
P.I.			

HRB Class. Group Index Ph

STABILOMETER TEST Data

Operator

cc. Temp. H²O	A	B	C	D
Cc. H²O added				
% H²O added				
Initial % H²O				
Molding % H²O				
Molding Density				
Compactor pressure				
No. blows				
Wt. in mold				
Wt. in mold (soaked)				
Wt. of mold ------>				
Net wt. of soil				
Height				
Exudation pressure				
Swell pressure				
Drainage				
Stabil. "Ph" - 500 No.				
" - 1000 No.				
" - 2000 No.				
Displacement "D"				
"R" value				
Gravel equivalent				
Swell equivalent				

REQ'D SURF. DEPTH: BY "R" _____ By Swell _____

TRAFFIC INDEX

REQ'D SURF. DEPTH: By "R": _____

Swell Pressure _____ psi

Surfacing Depth _____ ft.

Remarks:

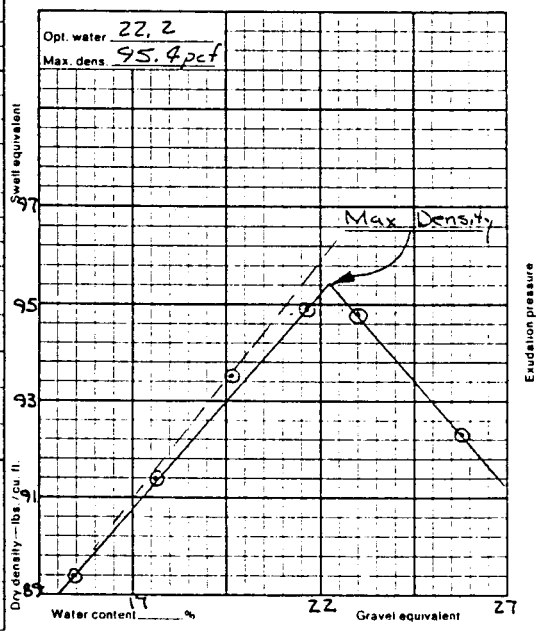
LAB NO. 27102

BIN NO.

MOISTURE-DENSITY (AASHO T-99-57)

Hyg. Water Cont. % Date Operator Jones

Can No.	94	95	96	97	98	99
Est. % H²O	12.0	14.0	16.0	18.0	20.0	22.0
Spec. wt.	1573	1635	1700	1755	1773	1765
Wet wt.	59.89	66.87	68.93	70.46	75.33	83.62
Dry wt.	51.76	56.87	57.65	57.95	61.22	66.54
Wt. H²O	8.13	10.00	11.28	12.51	14.11	17.08
% H²O	15.8	17.6	19.6	21.6	23.0	25.7
Dry density	89.4	91.4	93.5	94.9	94.8	92.3



DOT FORM 351 007 REVISED 5/85 1025

WHITE COPY—Grading & Constants YELLOW COPY—Stabilometer

Figure 2

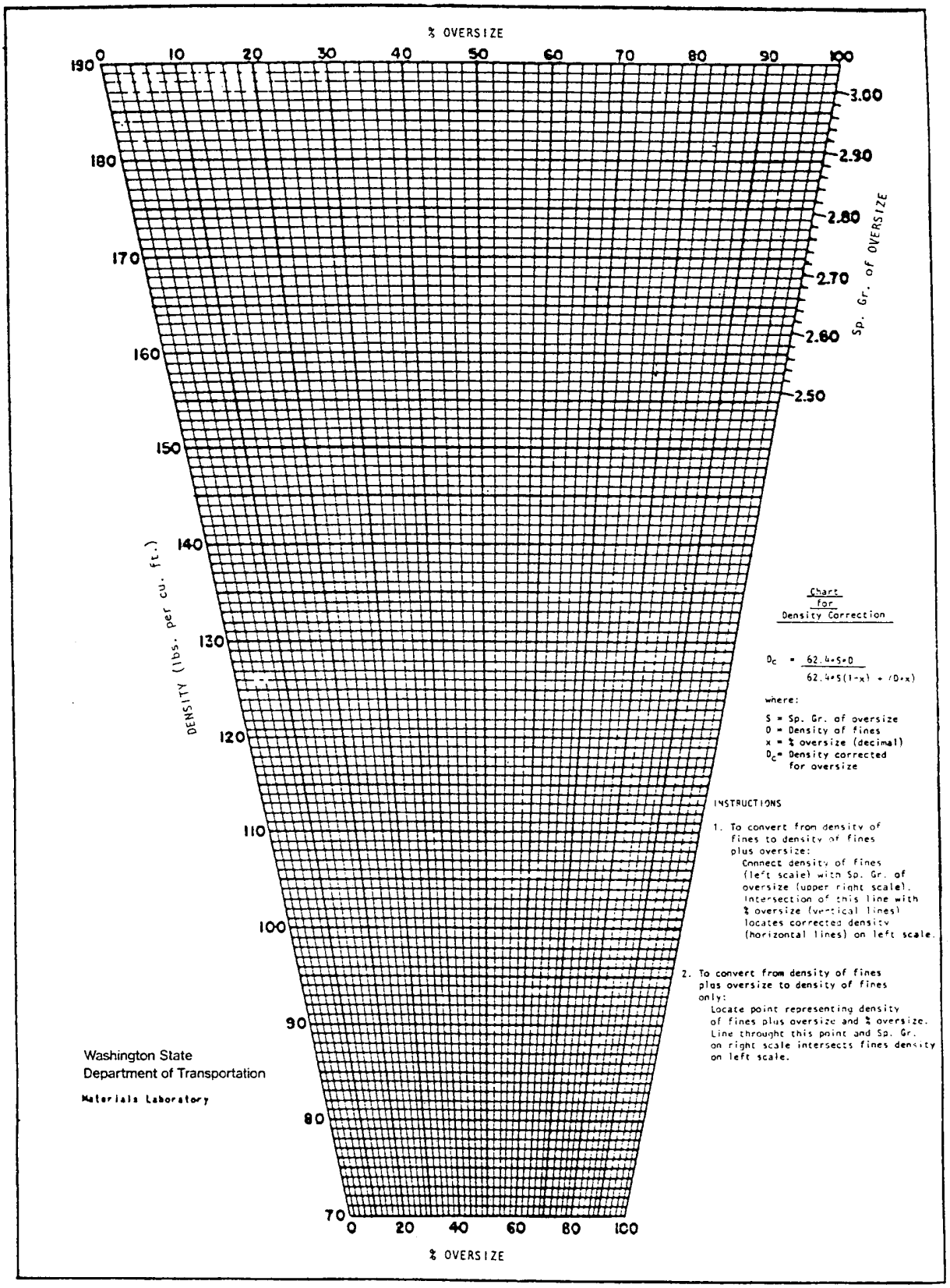

% OVERSIZE
0 10 20 30 40 50 60 70 80 90 100
190
180
170
160
150
140
130
120
110
100
90
80
70
3.00
2.90
2.80
2.70
2.60
2.50
Sp. Gr. of OVERSIZE
DENSITY (lbs. per cu. ft.)
0 20 40 60 80 100
% OVERSIZE
Chart for Density Correction
$D_c = \frac{62.4*S*D}{62.4*S(1-x) + (D*x)}$
where:
S = Sp. Gr. of oversize
D = Density of fines
x = % oversize (decimal)
D_c = Density corrected for oversize
INSTRUCTIONS
1. To convert from density of fines to density of fines plus oversize: Connect density of fines (left scale) with Sp. Gr. of oversize (upper right scale). Intersection of this line with % oversize (vertical lines) locates corrected density (horizontal lines) on left scale.
2. To convert from density of fines plus oversize to density of fines only: Locate point representing density of fines plus oversize and % oversize. Line throught this point and Sp. Gr. on right scale intersects fines density on left scale.
Washington State
Department of Transportation
Materials Laboratory

Figure 3

FIELD DENSITY TEST REPORT
NUCLEAR MOISTURE-DENSITY GAUGE METHOD

DEPARTMENT OF TRANSPORTATION
WORK SHEET

Contract No. 2845 SR No. 600 Section SR 503 to Ward Road
Inspector L. Peter Date 1-15-87

* TEST HOLE NO.	14	15		TC 2	TC 2A	
Station to Station						
* Test Station	14+60	24+80		3+45	3+45	
* Reference to Center Line	12' Lt	9' Rt		4' Rt	4' Rt	
* Reference to Subgrade	-3.6	-1.0		+.80	+.80	
* Material (Silt, Clay, Top Course, etc.)	Bc Sdy St	B.S silt		C STC	C STC	
Depth of Material (If surfacing)				0.20	0.20	

DENSITY "DETERMINATION"

Wet Density lbs/cu ft 0	124.4	127.6		138.4	146.6	
90	125.2	124.9		138.0	149.8	
Wet Density lbs/cu ft (test) Avg.	124.8	126.3		138.2	145.7	
Dry Density lbs/cu ft 0	—	—		—	—	
90	—	—		—	—	
* Dry Density lbs/cu ft (test) Avg.	106.1	109.4		132.8	135.4	
Moisture lbs/cu ft 0	—	—		—	—	
90	—	—		—	—	
Moisture lbs/cu ft (test) Avg.	—	—		—	—	
Moisture % 0	18.2	16.9		4.7	7.9	
90	17.3	17.3		4.1	8.3	
Moisture % (test) Avg.	17.8	17.1		4.4	8.1	
Moisture (Correction K)	—	—		—	—	
* Dry Density lbs/cu ft (Max.)	110.2	110.2		141.8	141.0	
* Dry Density lbs/cu ft (Max. Corr)	—	116.0		—		
* Dry Density lbs/cu ft (% of Max)	96.3	94.3		93.7	96.0	
Standard No.	4934	4934		4660	4660	

MOISTURE DETERMINATION

Wt. Damp Soil + Tare	9.81	10.35		12.16	12.56	
Wt. Dry Soil + Tare	8.65	9.17		11.76	11.84	
Wt. of Moisture	1.16	1.18		.40	.74	
Wt. of Tare	2.05	1.98		2.05	2.05	
Wt. Dry Soil	6.60	7.19		9.71	9.77	
* Moisture % (test)	17.6	16.4		4.1	7.6	
* Moisture % (optimum)	17.2	17.2		7	7	
* Moisture % (corrected)	—	14.6		—	—	

GRADATION DETERMINATION (Use Dry Sample from Moisture Determination)

Wt. Retained on No. 4 Sieve + Tare		3.06		7.16	7.71	
Wt. of Tare		1.98		2.05	2.05	
Wt. of Material Retained on No. 4 Sieve		1.08		5.11	5.66	
Wt. of Dry Soil		7.19		9.71	9.77	
% Retained No. 4 Sieve (% Oversize)		15		53	58	
% Passing No. 4 Sieve (100 – % Retained)	100	85		47	42	

NOTE: If retest, add letter to number such as 1st test No. 27, retest 27A

* *Information to be transferred to DOT 351-015 – DAILY COMPACTION TEST REPORT*

$$\% \text{ Moisture} = \frac{\text{Wt of Moisture} \times 100}{\text{Wt. of Dry Soil}} \qquad \text{Wet Density} = \frac{\text{Wt of Wet Soil}}{\text{Vol. of Hole}}$$

1 gram = 0.0022 lbs
1 lb = 453.6 grams

$$\text{Dry Density} = \frac{\text{Wet Density}}{1 + \frac{\% \text{ Moisture}}{100}}$$

$$\% \text{ Retained No. 4 Sieve} = \frac{\text{Wt. Retnd. No. 4 Sieve}}{\text{Wt. of Dry Soil}} \qquad \% \text{ Max. Density} = \frac{\text{Dry Density} \times 100}{\text{Max Density}}$$

$$\text{Moist Corr. K} = \frac{\% \text{ M (true)} - \% \text{ M (gauge)}}{\% \text{ M (gauge)} + 100} \times 1000$$

DOT FORM 350-074 5/81

Figure 4

DAIL . .OMPACTION TEST REPORT

DEPARTMENT OF HIGHWAYS

Project Engineer B. Pierce

Cont. No. 2845

Contractor Cascade

Date 1-15-87

Project Name SR-503 to Ward Road

Page No. 1 of 1

TEST NO.	STATION AND REF. TO C/L	REF. TO SUB GRADE	TYPE OF MATERIAL AND USE	MOISTURE PERCENT			PERCENT PASSING # 4 SIEVE	DRY DENSITY PCF					Method OF COMP	CHECK ONE	
				Opt.	Opt. Corrected	Field Test		Max.	Corr.	Std. No.	Field Test	% Max.		Sat.	Fail*
14	14+60/12'Lt	-3.6	Brn. Sndy Silt	17.2	—	17.6	100	110.2	—	4934	106.1	96.3	B	✓	
15	24+80/7'Rt	-1.0	" " "	17.2	14.6	16.4	85	110.2	116.0	4934	109.4	94.3	B	✓	
TC 2	3+45/4'Rt	+.8	C.S.T.C.	7	—	4.1	47	141.8	—	4660	132.8	93.7	95		✓
TC2A	3+95/4'Rt	+.8	"	7	—	7.6	42	141.0	—	4660	135.4	96.0	95	✓	
	4+50-55~	-14	Rock Embk										RO	✓	

Optimum Moisture – Moisture content of No. 4 minus from Proctor curve.
Corrected Moisture – Optimum moisture corrected for oversize = Optimum Moisture Content X Percent Passing No. 4 Sieve.
Maximum Dry Density – Density from Proctor curve or Maximum Density for Granular Materials Curve.
Corrected Density – Proctor Maximum Dry Density corrected for oversize.
Standard Number – Laboratory or identifying number of Density Standard used, i.e., Proctor No. or Maximum Density Curve No.
Field Test – Moisture content or Density of field sample tested.
Method of Compaction (Specified): A, B, C, Rock Embankment (RO), Bridge Approach Embankment (BA)

* Note corrective action under remarks:

SUMMARY OF COMPACTION QUANTITIES

TEST NO'S.	LIFT THICK.	COMPACTION EQUIPMENT USED (Number, Weight and Type of Units)	NO. OF COVERAGES PER LIFT	DAILY QUANTITIES (C.Y. or Ton)	ACCUM. TOTAL QUANTITIES	NO. OF DENSITY TESTS REQUIRED TO-DATE
14 & 15	8"/4"	2 - 11 ton S.D.V.	6	3,500 CY	67,000 CY	27
TC 2	.20	1 - 11 ton S.D.V.	4-6	2,000 Ton	4,000 Ton	1
ROCK EMB.	18"	1 - 50 Ton Grid Roller	3	2,000 CY	10,000 CY	—

DISTRIBUTION:
Hdq. Const. Engr.
District Const. Engr
Project Engr.
Dists. Soils Engr.
HWY FORM 351-015(HF 26 731)
REVISED 3/73

REMARKS: Test #15 Above 94% contractor rolled 2 additional passe
TC-2 contractor water CSTC and rolled 2 passes, retest
passed

INSPECTOR

Figure 5

WSDOT Test Method No. 807

Method of Operation of California Profilograph and Evaluation of Profiles

1. SCOPE

   a. The operation of the California Profilograph, the procedure used for determining the Profile Index from profilograms of pavements made with the Profilograph, and the procedure used to locate individual high points in excess of 7.62 mm (0.3 in.) are described in Parts I, II, and III, respectively, in this test method.

Part I

Operation of the California Profilograph

2. PROCEDURE

   a. Equipment

      The California Profilograph consists of a frame 7.62 m (25 LF) long supported upon multiple wheels at either end arranged in a staggered pattern such that no two wheels cross the same bump at the same time. The profile is recorded from the vertical movement of a wheel attached to the frame at mid-point and is in reference to the mean elevation of the 12 points of contact with the road surface established by the support wheels (see Figure 1). The profilogram is recorded on a scale of 25 mm = 7620 mm (1 in. = 25 LF) longitudinally and 25 mm = 25 mm (or full scale) vertically. Motive power is provided manually.

   b. Operation

      The instructions for assembling the Profilograph are contained in a booklet accompanying each unit. Particular attention should be paid to the listed precautions.

      In operation, the Profilograph should be moved at a speed no greater than a walk so as to eliminate as much bounce as possible. Too high a speed will result in a profilogram that is difficult to evaluate.

      Calibration of the Profilograph should be checked periodically. The horizontal scale can be checked by running a known distance and scaling the result on the profilogram. If the scale is off, the profile wheel should be changed to one of a proper diameter. The vertical scale is checked by putting a board of known thickness under the profile wheel and again scaling the result on the profilogram. If the scale is off, the cause of the incorrect height should be determined and corrected.

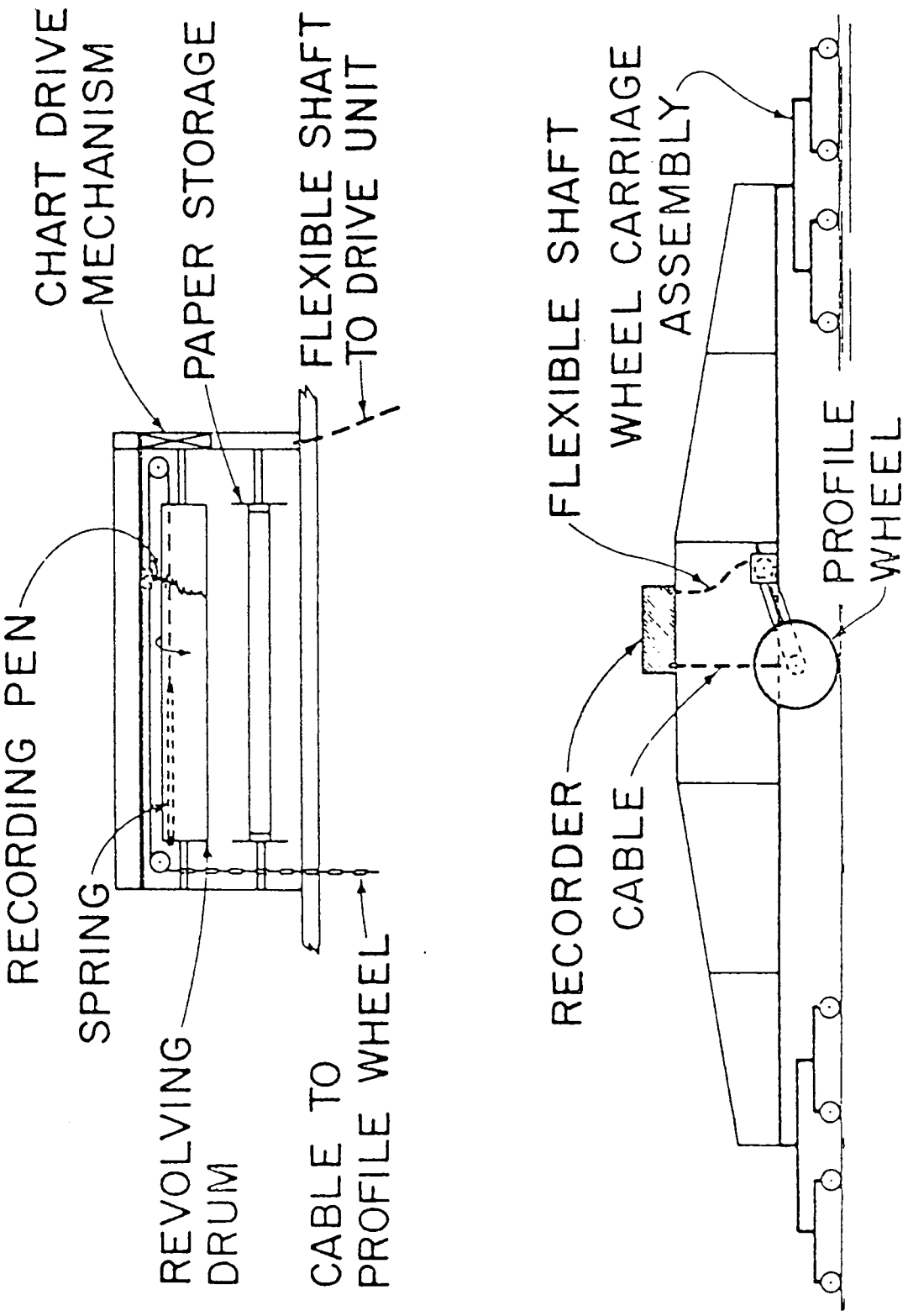


CHART DRIVE MECHANISM
PAPER STORAGE
FLEXIBLE SHAFT TO DRIVE UNIT
RECORDING PEN
SPRING
REVOLVING DRUM
CABLE TO PROFILE WHEEL
FLEXIBLE SHAFT
WHEEL CARRIAGE ASSEMBLY
PROFILE WHEEL
RECORDER CABLE

Figure 1

3. PROCEDURE

a. Equipment

To determine the Profile Index, use a plastic scale 43.18 mm (1.70 LF) wide and 536.45 mm (1.70 in.) long representing a pavement length of 161 m (528 LF) at a scale of 25 mm = 7.62 m a plastic scale for the Profilograph may be obtained by the districts from the Headquarters Materials Laboratory. Near the center of the scale is an opaque band 5.1 mm wide extending the entire length of 536.45 mm (21.12 in.). On either side of this band are scribed lines 2.54 mm (0.1 in.) apart, parallel to the opaque band. These lines serve as a convenient scale to measure deviations or excursions of the graph above or below the blanking band. These are called “scallops.”

b. Method of Counting

Place the plastic scale over the profile in such a way as to “blank out” as much of the profile as possible. When this is done, scallops above and below the blanking band usually will be approximately balanced. See Figure 2.

The profile trace will move from a generally horizontal position when going around super-elevated curves making it impossible to blank out the central portion of the trace without shifting the scale. When such a condition occurs, the profile should be broken into short sections and the blanking band repositioned on each section while counting as shown in the upper part of Figure 3.

Starting at the right end of the scale, measure and total the height of all the scallops appearing both above and below the blanking band, measuring each scallop to the nearest 1.27 mm (0.05 in.) (half a tenth). Write this total on the profile sheet near the left end of the scale together with a small mark to align the scale when moving to the next section. Short portions of the profile line may be visible outside the blanking band but unless they project 0.762 mm (0.03 in.) or more and extend longitudinally for 610 mm (2 LF) (2 mm (0.8 in.) on the profilogram) or more, they are not included in the count. (See Figure 2 for illustration of these special conditions.)

When scallops occurring in the first 161 m (0.1 mile) are totaled, slide the scale to the left, aligning the right end of the scale with the small mark previously made, and proceed with the counting in the same manner. The last section counted may or may not be an even 161 m (0.1 mile). If not, its length should be scaled to determine its length in kilometers. An example follows:

	Section length, km	**Counts, tenth of an in.**
	0.16 (0.10 miles)	5.0
	0.16 (0.10 miles)	4.0
	0.16 (0.10 miles)	3.5
122 m =	0.122	2.0
Total	0.602	14.5

The Profile Index is determined as “inches per mile in excess of the 5.1 mm (0.2 in.) blanking band” but is simply called the Profile Index. The procedure for converting counts of Profile Index is as follows:

Using the figures from the above example:

Length = 0.605 km (0.376 mi.), total count = 14.5 mm (14.5 tenths of an inch)

$$\text{Profile Index} = \frac{\text{1 km (1 mi.)}}{\text{length of profiles in km (miles)}} \times \text{a total count in mm}$$

$$\text{Pr I} = \frac{1 \text{ km}}{0.605 \text{ km}} \times 1.45 = 2.4$$

(Note that the formula uses the count in mm rather than tenths of a mm and is obtained by dividing the count by ten.)

The Profile Index is thus determined for the profile of any line called for in the specifications.

To determine the daily profile index to check the Contractors methods and procedures, profile indexes may be averaged for two or more profiles of the same section of road if the profiles are the same length.

Example:

		Counts, tenths of an inch	
	Section length, km (mi.)	**Left wheel track**	**Right wheel track**
	0.10 (0.26)	5.0	4.5
	0.10 (0.26)	4.0	5.0
	0.10 (0.26)	3.5	3.0
121.9 m (400 LF)=	0.076 (0/0 mi.)	2.0	1.5
Total	0.376	14.5	14.0
PrI (by formula)		3.9	3.7

$$\text{Averages} = \frac{3.9 + 3.7}{2} = 3.8$$

The specifications state which profiles to use when computing the average Profile Index for control of construction operations.

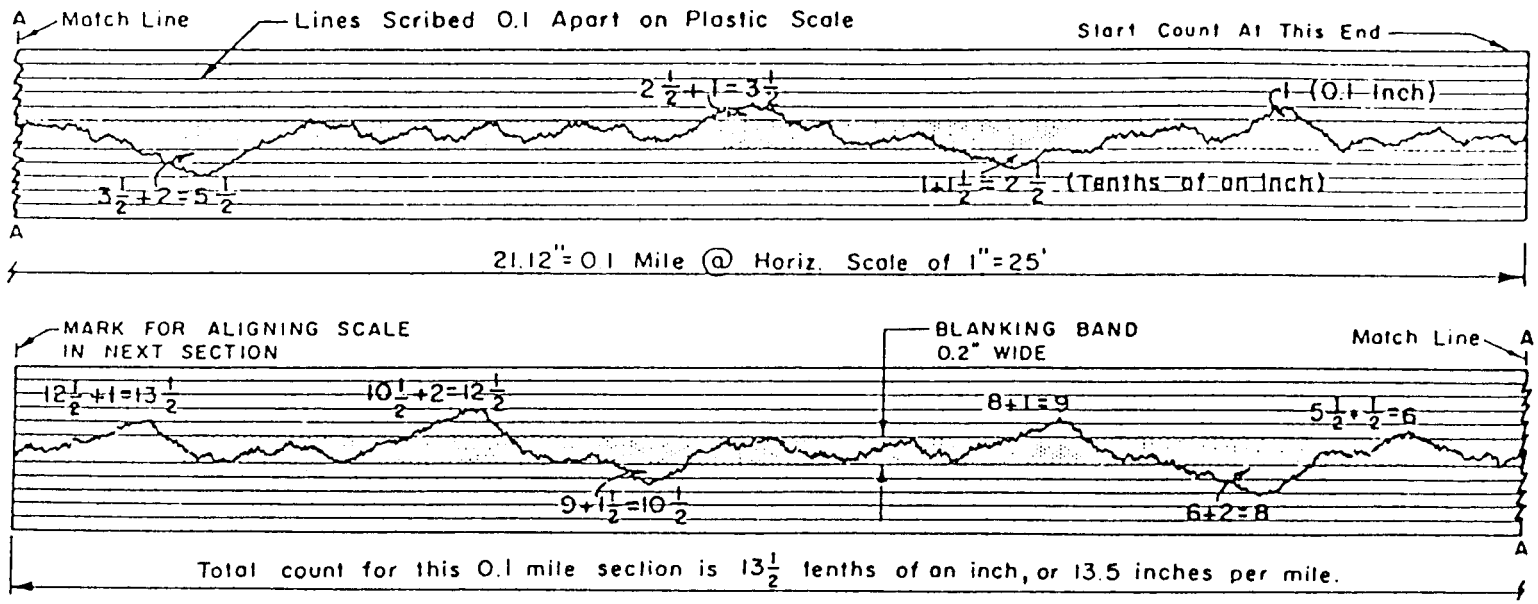
c. Limitations of Count in 0.1 km (0.1 mi.) Sections

When the specifications limit the amount of roughness in “any one-tenth mile section,” the scale is moved along the profile and counts made at various locations to find those sections if any, that do not conform to specifications. The limits are then noted on the profile and can be later located on the pavement preparatory to grinding.

d. Limits of Counts — Joints

When counting profiles, a day’s paving is considered to include the last portion of the previous day’s work, which includes the daily joint. The last 4.57 to 9.14 m (15 to 30 LF) of a day’s paving cannot usually be obtained until the following day. In general, the paving contractor is responsible for the smoothness of joints if he places the concrete pavement on both sides of the joint. On the other hand, the contractor is responsible only for the pavement placed by him if the work abuts a bridge or a pavement placed under another contract. Profilograph readings when approaching such joints should be taken in conformance with current specifications.

EXAMPLE SHOWING METHOD OF DERIVING PROFILE INDEX FROM PROFILOGRAMS



TYPICAL CONDITIONS

SPECIAL CONDITIONS

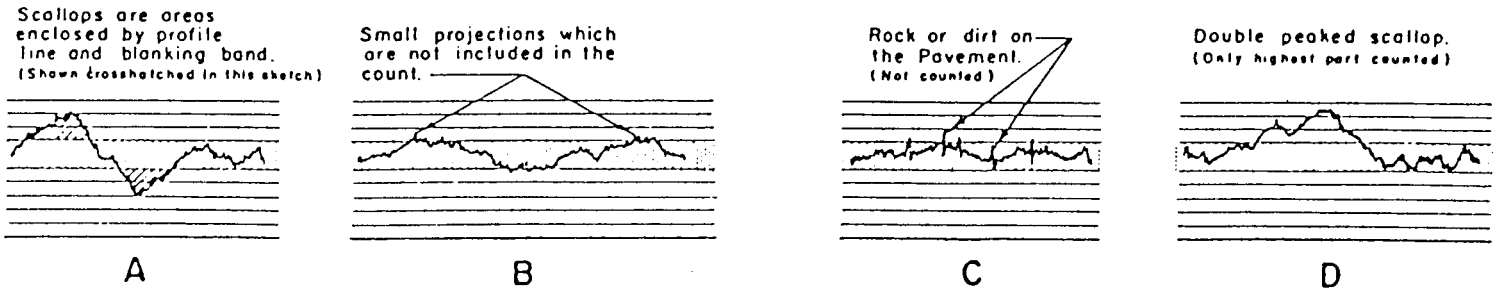


Figure 2

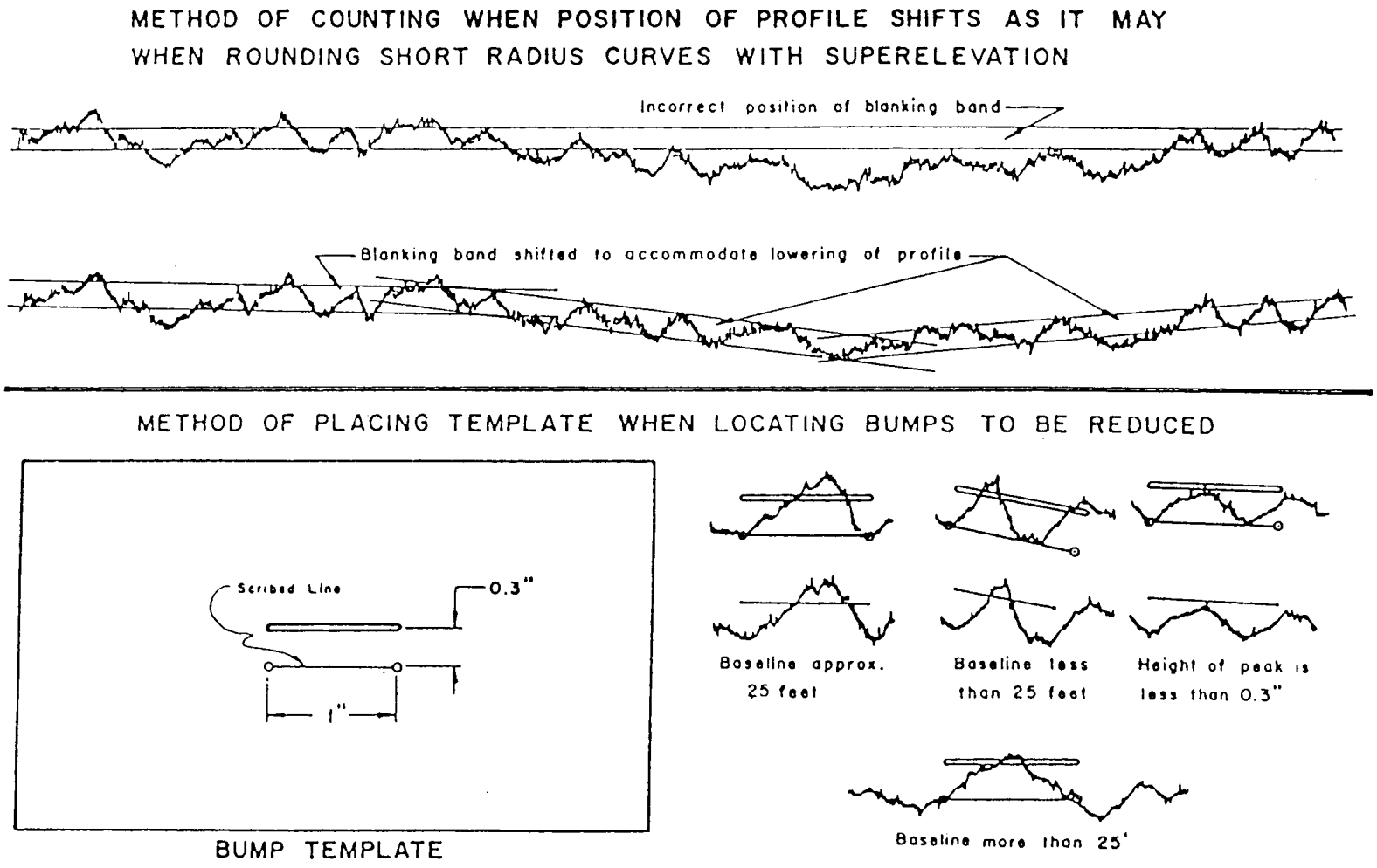

METHOD OF COUNTING WHEN POSITION OF PROFILE SHIFTS AS IT MAY
WHEN ROUNDING SHORT RADIUS CURVES WITH SUPERELEVATION
Incorrect position of blanking band
Blanking band shifted to accommodate lowering of profile
METHOD OF PLACING TEMPLATE WHEN LOCATING BUMPS TO BE REDUCED
Scribed Line
0.3"
1"
BUMP TEMPLATE
Baseline approx. 25 feet
Baseline less than 25 feet
Height of peak is less than 0.3"
Baseline more than 25'

Figure 3

Part III

Determination of High Points in Excess of 7.62 mm (0.3 in.)

4. PROCEDURE

a. Equipment

Use a plastic template having a line 25.4 mm (1 in.) long scribed on one face with a small hole or scribed mark at either end, and a slot 7.62 mm from and parallel to the scribed line. See Figure 3. (The 25.4 mm (1 in.) line corresponds to a horizontal distance of 7.62 m (0.3 in.) on the horizontal scale of the profilogram.) The plastic template may be obtained from the Olympia Service Center Materials Laboratory.

b. Locating High Points in Excess of 7.62 mm (0.3 in.).

At each prominent peak or high point on the profile trace, place the template so that the small holes or scribe marks at each end of the scribed line intersect the profile trace to form a chord across the base of the peak or indicated bump. The line on the template need not be horizontal. With a sharp pencil, draw a line using the narrow slot in the template as a guide. Any portion of the trace extending above this line will indicate the approximate length and height of the deviation in excess of 7.62 mm (0.3 in.).

There may be instances where the distance between easily recognizable low points is less than 25.4 mm (1 in.) (7.62 m (30 LF)). In such cases, a shorter chord length shall be used in making the scribed line on the template tangent to the trace at the low points. It is the intent, however, of this requirement that the baseline for measuring the height of bumps will be as near 7.62 m (30 LF) (25.4 mm (1 in.)) as possible, but in no case to exceed this value. When the distance between prominent low points is greater than 7.62 m (0.3 in.) (25.4 mm (1 in.)), make the ends of the scribed line intersect the profile trace when the template is in a nearly horizontal position. A few examples of the procedure are shown in the lower portion of Figure 3.

8:P:DP/MM

Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Penetration of Bituminous Materials	201	**T 49**		
Kinematic Viscosity of Asphalts	203	**T 201**		
Viscosity of Asphalts by Vacuum Capillary Viscometer	203	**T 202**		
Saybolt Viscosity	204	**T 72**		
Flash and Fire Points by Cleveland Cup	206	**T 48**		
Flash Point with Tag Open-Cup Apparatus for Use with Materials Having a Flash Less Than 93.3°C(200°F)	207	**T 79**		
Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin-Film Test)	208	**T 240**		
Sampling Bituminous Materials	210	***T 40*** ✓		Binder
Distillation of Cut-Back Asphaltic (Bituminous) Products	211	**T 78**		
Testing Emulsified Asphalts	212	**T 59**		
Ductility of Bituminous Materials	213	**T 51**		
Solubility of Bituminous Materials	214	**T 44**		
Softening Point of Bitumen (Ring and Ball Apparatus)	216	**F 53**		
Water in Petroleum Products and Bituminous Materials by Distillation	217	**T 55**		
Float Test for Bituminous Materials	218	**T 50**		
Specific Gravity or API Gravity of Liquid Asphalts by Hydrometer Method	219	**T 295**		
Specific Gravity of Semi-Solid Bituminous Materials	221	**T 228**		
Density of Solid Pitch and Asphalt (Displacement Method)	222	**T 229**		
pH of Aqueous Solutions with the Glass Electrode	223	**T 200**		

– Bold text indicates the method to be used.

– Italics indicates that the test method is included in this manual.

– A check mark indicates the method is a Field Operation Procedure, which is a WSDOT field method, or nationally recognized standard abbreviation for field use.

Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency	301	**T 162**		
Normal Consistency of Hydraulic Cement	302	**T 129**		
Time of Setting of Hydraulic Cement by Vicat Needle	304	**T 131**		
Fineness of Portland Cement by Air Permeability Apparatus	306	**T 153**		
Compressive Strength of Hydraulic Cement Mortars (2-in. or 50 mm Cube Specimens)	307	**T 106**		
Autoclave Expansion of Portland Cement	309	**T 107**		
Air Content of Hydraulic Cement Mortar	310	**T 137**		
Density of Hydraulic Cement	312	**T 133**		
Cement — Latex Compatibility	***313***			Cement
Photovolt Reflectance	***314***			Cement
Chemical Analysis of Hydraulic Cement	401	**T 105**		
Weight of Coating on Zinc-Coated (galvanized) Iron or Steel Articles	402	**T 65**	**E 376**	
Method of Test for Compressive Shear (Double) Strength of Epoxy Resin	***404***			Chemical
Method of Test for Diagonal Shear Strength Test (Arizona Composite Cylinder Test)	***405***			Chemical
Method of Test for Quality of Water to be Used in Mixing Concrete	***408***			Chemical
Method of Test for Water Absorption and Moisture Vapor Transpiration	***411***			Chemical

– Bold text indicates the method to be used.

– Italics indicates that the test method is included in this manual.

– A check mark indicates the method is a Field Operation Procedure, which is a WSDOT field method, or nationally recognized standard abbreviation for field use.

Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Method of Test for Joint Sealers Bond Test	***412***			Chemical
Method of Test for Evaluating Waterproofing Effectiveness of Membranes and Membrane Pavement System	***413***			Cement
Method of Test for Chloride in Concrete Bridge Decks, Length Change of Hardened Hydraulic Cement Mortar and Concrete	***414***			Chemical
Method of Test for Fertilizer	***415***			Chemical
Method of Test for Determining Minimum Resistivity and pH of Soil and Water	***417***			Aggregates
Corrosion of Deicing Materials	***418***			Chemical
Impact Resistance: Rebar Feet	***419***			Chemical
Method for Determination of Drying Time (Oil-Based Paints)	501		**4061**	
Method for Determination of Nonvolatile Vehicle Content	502		**4053**	
Method for Determination of Condition in Container	503		**3011**	
Method for Determination of Consistency of Pigment Materials (Kerbs-Stormer Viscometer)	504		**D 562**	
Method for Determination of Volatile and Nonvolatile Content (Ordinary Laboratory Oven)	505		**D 2369**	
Method for Determination of Pigment Content (Ordinary Centrifuge)	506		**4021**	
Method for Determination of Hiding Power (Contrast Ratio)	507		**4122**	

– Bold text indicates the method to be used.

– Italics indicates that the test method is included in this manual.

– A check mark indicates the method is a Field Operation Procedure, which is a WSDOT field method, or nationally recognized standard abbreviation for field use.

Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Method for Determination of Weight Per Gallon	508		**D 1475**	
Method for Determination of Fineness of Grind	509		**4411**	
Method for Determination of Loss on Ignition	512		**D 1208**	
Method of Test for Determination of 45 Degree, Directional Reflectance	513		**E 1347**	
Method of Test for Sieve Analysis of Soils-Coarse Sieving	***601***			Pavement — Soils
Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test	602	**T 87**		
Particle Size Analysis of Soils	603	**T 88**		
Specific Gravity of Soils	604/906	**T 100**		
Method of Test for Compaction Control of Granular Materials	***606***			Pavement — Soils
Determining the Liquid Limit of Soils	607	**T 89**		
Determining the Plastic Limit and Plasticity Index of Soils	608	**T 90**		
The Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop	***609*** ✓	T 99		Pavement — Soils
Method of Test for the Capillary Rise of Soils	***610***			Pavement — Soils
Method of Test for Determination of the Resistance ("R" Value) of Untreated Bases, Subbases, and Basement Soils by the Stabilometer	***611***	T 190 Mod		Pavement — Soils
Method for Determining In-Place Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/Density Gauge	***613***			Pavement — Soils

– Bold text indicates the method to be used.

– Italics indicates that the test method is included in this manual.

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Resilient Modulus of Unbound Granular Base/Subbase Materials and Subgrade Soils	614	**T 294 Mod**		
Method for Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor	***702***			Bituminous Concrete
Method of Test for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of HVEEM Stabilometer	***703***			Bituminous Concrete
Method s of Test for Specific Gravity and Weight per Cubic Foot of Compacted Asphalt Mixtures	***704***			Bituminous Concrete
Method of Test for Maximum Specific Gravity of Bituminous Paving Mixtures — "Rice Density"	705	***T 209 ✓***		Bituminous Concrete
Method of Static Immersion Asphalt in Water Preferential Stripping Test	***706***			Bituminous Concrete
Standard Method of Sampling Bituminous Paving Mixtures	***712 ✓***	T 168 Mod		Bituminous Concrete
Bituminous Concrete				
Method of Test for Moisture in Bituminous Mixtures	***713***			Bituminous Concrete
Method of Test for Determining Degree of Particle Coating of Bituminous Aggregate Mixtures "Ross Count"	714	**T 195 Mod**		
Method of Test for Relative Compaction of Asphalt Concrete Pavement	***715 ✓***			Bituminous Concrete
Method of Random Sampling for Location of Testing and Sampling Sites	***716 ✓***			Bituminous Concrete
Method of Test for Determining Stripping of Asphalt Concrete	***718***			Bituminous Concrete

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Method of Test for Thickness Measurement of Asphalt Concrete Cores	***720***			Bituminous Concrete
Method of Test for Determination of Asphalt Content by Nuclear Method	***722*** ✓			Bituminous Concrete
Method for Preparation of Aggregate for ACP Job Mix Design	***724***			Bituminous Concrete
Method of Test for Field Verification of a Job Mix Calibration for the Nuclear Asphalt Content Gauge	***725*** ✓			Bituminous Concrete
Mix Procedure for Asphalt Concrete	***726***			Bituminous Concrete
Method of Sacking Aggregate for ACP Job Mix Designs	***727***			Bituminous Concrete
Compressive Strength of Cylindrical Concrete Specimens	801	T 22		
Flexural Strength of Concrete [Using Simple Beam with Center-Point Loading]	***802*** ✓			Concrete
Sampling Freshly Mixed Concrete	803	***T 141*** ✓		Concrete
Slump of Hydraulic Cement Concrete	804	***T 119*** ✓		Concrete
Air Content of Freshly Mixed Concrete by the Pressure Method	805	***T 152*** ✓		Concrete
Weight Per Cubic Foot, Yield, and Air Content [Gravimetric] of Concrete	806	***T 121*** ✓		Concrete
Method of Operation of California Profilograph an Evaluation of Profiles	***807*** ✓			Pavement — Soils
Flexural Strength of Concrete [Using Simple Beam with Center-Point Loading]	***808*** ✓	T 177 Mod		Concrete
Making and Curing Concrete Test Specimens in the Field	809	***T 23 Mod*** ✓		Concrete

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Method of Test for Determination of the Density of Portland Cement Concrete Pavement Cores	810	**T 85 Mod**		
Capping Cylindrical Concrete Specimens	811	**T 231**		
Measuring Length of Drilled Concrete Cores	812	**T 148**		
Field Method of Fabrication of 2-Inch Cube Specimens for Compressive Strength Testing of Grouts and Mortars	***813*** ✓			Concrete
Water Retention of Curing Compounds	***814***			Cement
Method of Test for Quality of Concrete Aggregates using the Steilacoom Comparison	***815***			Concrete
Method of Test for Unconfined Compressive Strength of Soils	901	**T 208**		
Method of Test for Unconsolidated Undrained Triaxial Shear	902	**T 296**		
Method of Test for Consolidated Undrained Triaxial Shear	903		**F 297**	
Method of Test for Consolidation	904	**T 216**		
Method of Test for Direct Shear, Ultimate and Residual Strength Values	905	**T 236**		
Method of Test for Permeability	910	**T 215**		
Identification and Classification of Soils for Engineering Purposes	911		**D 2487**	
Method of Test for Percentage of Moisture of a Soil Sample	912	**T 265**		
Practice for Sampling of Geotextiles for Testing	***914***			Physical Testing
Conditioning of Geotextiles	***915***			Physical Testing
Grab Breaking Load	916		**D 4632**	

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Wide Width Breaking Load	917		**D 4595**	
Sewen Seams	918		**D 1683**	
Tear Strength	919		**D 4533**	
Hydraulic Bursting Strength of Knitted Goods and Nonwoven Firebricks	920		**D 3786**	
Index Puncture Resistance of Geotextiles, Geomembranes and Related Products	921		**D 4833**	
Apparent Opening Size	922		**D 4751**	
Thickness of Geotextiles	***923***			Physical Testing
Water Permeability	924		**D 4491**	
Proposed Test Method for Rheological Measurements of Bitumen's by Vacuum Capillary Viscometer		**D 4(P 159)**		
Practice of Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel		**PP 1**		
Practice for Grading or Verifying the Performance Grade of an Asphalt Binder		**PP 6**		
Making and Curing Concrete Test Specimens in the Laboratory		**T 126**		
Joint Sealer Flow Test		**T 187**		
Air Content of Freshly Mixed Concrete by the Volumetric Method		**T 196**		
Splitting Tensile Strength of Cylindrical Concrete Specimens		**T 198**		
Sampling of Aggregates		***T 2*** ✓		Aggregates
Obtaining and Testing Drilled Cores and Sawed Beams of Concrete		**T 24**		
Frictional Properties of Paved Surfaces Using a Full-Size Tire		**T 242**		

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Mechanical Testing — Steel		**T 244**	**A 370**	
Instrumental Photometeric		**T 257**		
Determination of Organic Content in Soils by Loss on Ignition		**T 267**		
Percent Voids in Bituminous Mixtures		**T 269**		
Electrical Indication of Concrete's Ability to Resist Chloride		**T 277**		
Road Profile		**Tentative**	**Tentative**	
Test Method for Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)		**TP 1**		
Test Method for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)		**TP 5**		
Method for Determination of the Temperature of Freshly Mixed Concrete			***C 1064*** ✓	Concrete
Absorption and Compressive Strength of Concrete Masonry Units			**C 140**	
Compressive Strength of Lightweight Insulated Concrete			**C 495**	
Unconfined Compressive Strength of Rock Cores			**C 2938**	
Compressive Strength Chemical Resistant Mortars			**C 579**	
Method for Determination of Concrete Strength by Rebound Number			***C 805*** ✓	Concrete
Compressive Set: Rubber			**D 395**	
Rubber Tensile Test			**D 412**	
Crossed-Linked			**D 470**	

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Test Method for Consistency of Paints Using the Stormer Viscometer			**D 562**	
Rubber Deterioration in Air			**D 573**	
Rubber Tear Test			**D 624**	
Ozone Deterioration: Rubber			**D 1149**	
pH of Water			**D 1293**	
Test Method for Density of Paint, Varnish, Lacquer, and Related Products			**D 1475**	
Calorimeter Analysis of Coal			**D 2015**	
Brittleness Point			**D 2137**	
Durometer Hardness			**D 2240**	
Visual Manual Soil Identification			**D 2488**	
Method of Test for Preformed Elastomeric Compressive Joint Seals of Concrete			**D 2628**	
Thermoplastic Insulation			**D 2633**	
Brookfield Viscosity			**D 4402**	
Test Method for Deflections with Falling-Weight-Type Impulse Load Device			**D 4694**	
Test Method for Nonvolatile Contents of Latexes			**D 4758**	
Retroreflective Sheeting			**D 4956 (E810)**	
Fine Grain Permeability			**D 5084**	
Melting Hot Applied Joint Filler			**D 5167**	
Infrared Quantitative Analysis			**E 168**	
Infrared Qualitative Analysis			**E 1252**	
Mechanical Properties: Steel Fasteners			**F 606**	

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Test Method	WSDOT No.	AASHTO No.	ASTM or Other National Method	Manual Section
Rock Direct Shear			**ASTM Proposed**	
Signal Controller Evaluation			**ATSI DMCT-700 Manual**	
Mod Emuls. Residue by Evap.			**CAL 331**	
Torsional Recovery			**CAL 332**	
Signal Controller Evaluation			**FHWA-IP-78-167 (7/85)**	
Rock Point Load			**ISRM Proposed**	
Signal Controller Evaluation			**NEMI TSI**	
Signal Controller Evaluation			**SCC Mod 1000 TS Manual**	
Determination of Asphalt Content From Asphalt Paving Mixtures By the Ignition Method			**VTM 102**	

26:P:DP/MM

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